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AERONAUTICS

Includes aeronautics (general); aerodynamics; air transportation and safety; aircraft communications and navigation; aircraft design, testing and performance; aircraft instrumentation; aircraft propulsion and power; aircraft stability and control; and research and support facilities (air).

For related information see also *Astronautics*.

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For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion*.

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84 LAW AND POLITICAL SCIENCE N.A.
Includes space law; international law; international cooperation; and patent policy.

85 URBAN TECHNOLOGY AND TRANSPORTATION 2335
Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.
For related information see *03 Air Transportation and Safety*, *16 Space Transportation*, and *44 Energy Production and Conversion*.

SPACE SCIENCES

Includes space sciences (general); astronomy; astrophysics; lunar and planetary exploration; solar physics; and space radiation.
For related information see also *Geosciences*.

88 SPACE SCIENCES (GENERAL) N.A.

89 ASTRONOMY 2338
Includes radio and gamma-ray astronomy; celestial mechanics; and astrometry.

90 ASTROPHYSICS 2339
Includes cosmology; and interstellar and interplanetary gases and dust.

91 LUNAR AND PLANETARY EXPLORATION N.A.
Includes planetology; and manned and unmanned flights.
For spacecraft design see *18 Spacecraft Design, Testing and Performance*. For space stations see *15 Launch Vehicles and Space Vehicles*.

92 SOLAR PHYSICS 2341
Includes solar activity, solar flares, solar radiation and sunspots.

93 SPACE RADIATION 2341
Includes cosmic radiation; and inner and outer earth's radiation belts.
For biological effects of radiation see *52 Aerospace Medicine*. For theory see *73 Nuclear and High-Energy Physics*.

GENERAL

99 GENERAL 2341

Note: N.A. means that no abstracts were assigned to this category for this issue.

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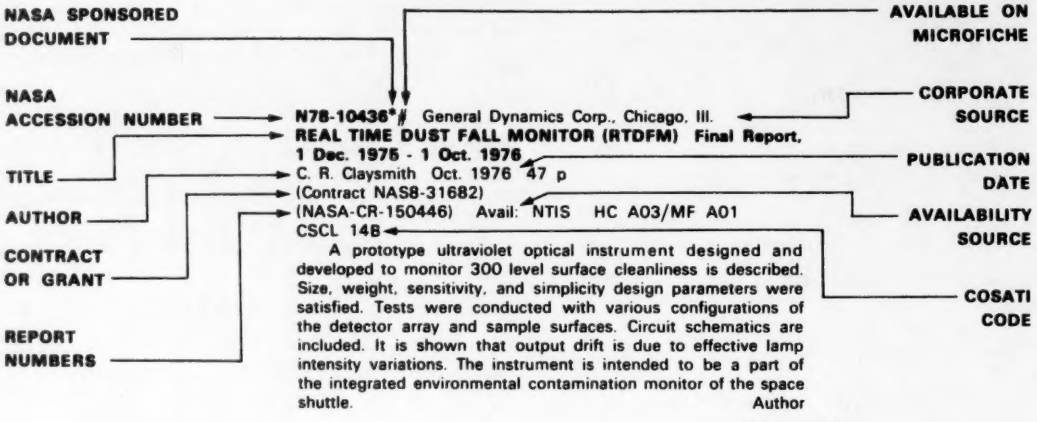
TYPICAL CITATION AND ABSTRACT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REAL TIME DUST FALL MONITOR (RTDFM) Final Report, 1 Dec. 1975 - 1 Oct. 1976
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REPORT NUMBERS
A prototype ultraviolet optical instrument designed and developed to monitor 300 level surface cleanliness is described. Size, weight, sensitivity, and simplicity design parameters were satisfied. Tests were conducted with various configurations of the detector array and sample surfaces. Circuit schematics are included. It is shown that output drift is due to effective lamp intensity variations. The instrument is intended to be a part of the integrated environmental contamination monitor of the space shuttle.
Author

ON-GOING RESEARCH PROJECTS

This is a listing of research projects— not publications

AERONAUTICS

Includes Aeronautics (general); Aerodynamics; Air Transportation and Safety; Aircraft Communications and Navigation; Aircraft Design, Testing, and Performance; Aircraft Instrumentation; Aircraft Propulsion and Power; Aircraft Stability and Control; and Research and Support Facilities (air). For Related Information See Also Astronautics.

1.0001, STUDY FOR SMALL AND LARGE AIRCRAFT STRUCTURAL LOADS CRITERIA BASED ON AIRCRAFT AND ATMOSPHERIC DYNAMICS

UNKNOWN, Systems Technology Inc., *Hawthorne, California* 90250 (FA77WA-3936; FA59976 (TRAIS NO.))

Task 1 - Perform an analysis to determine small aircraft structural loading imposed as a function of the aircraft stability, control and handling qualities characteristics to include the effects of human pilot inputs or the intervention of the pilot when an upset or abnormal flight condition occurs. Task 2 - Perform analysis the same as Task 1 for large aircraft structural loading.

SUPPORTED BY U.S. Dept. of Transportation, Federal Aviation Admin.

1.0002, DEFINE AND DEVELOP A COMBINED HAZARD INDEX

UNKNOWN, McDonnell Douglas Corporation, *Long Beach, California* 90808 (FA77WA-4019; FA160426 (TRAIS NO.))

The combined hazard index shall be time scaled against a specific post-crash cabin fire environment and cover an assumed maximum emergency evacuation period of five minutes. If a specific combustion hazard becomes critical within the five minute limit, it shall be identified and accounted for in the combined hazard ranking. The cabin fire environment shall be simulated by full-scale tests representative of an actual post-crash accident scenario and fire.

SUPPORTED BY U.S. Dept. of Transportation, Federal Aviation Admin.

1.0003, NEW CONCEPTS IN ADVANCED MATERIALS APPLICATIONS TO LANDING GEAR FOR MILITARY AIRCRAFT - CONCEPTS/CRITERIA

V.L. WILSON, Rockwell International Corp., *Los Angeles, California* 90009 (DF136220; F33615-76-C-3021)

Fatigue and corrosion are a major cause of metallic landing gear hardware failure resulting in high landing gear life-cycle costs. The objective of this work unit is to extend the AFFDL-developed technology in composite material landing gear hardware to the conceptual design study of complete composite material landing gear systems. This study will establish the cost and weight saving benefits that are possible through the maximum practical use of composite material landing gear hardware in complete landing gear systems. Composite material has excellent potential to save up to 40 percent weight for some landing gear hardware components and to extend the useful life of the gear due to its excellent corrosion and fatigue properties.

The work to be done will be based on the design requirements and constraints established for a current Air Force aircraft landing gear system. Using these parameters and the AFFDL-developed technology in composite material landing gear, complete new landing gear designs will be developed which make maximum practical use of composite material landing gear hardware. Initial acquisition and life-cycle cost benefits and weight savings benefits will then be established and comparisons made to the conventional metallic landing gear.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0004, ANALYSIS OF HIGH-SPEED EXIT TAXIWAYS

J.P. BRAAKSMA, Carleton University, *Ottawa, Ontario, Canada* (089136 (HRB NO.))

The research project involves the analysis of high-speed turn-offs which are exits designed to permit aircraft turning off the runways at approx. 60 MPH as compared to conventional right-angled exits where speeds as low as 10-20 MPH are used. One of the most important functions is to decrease the time required by a landing aircraft to clear the runway so as to increase the capacity of the runway; however, these exits have been observed to perform less effectively than anticipated as most aircraft turn off at slower speeds of 30-40 MPH. The concern about the apparent failure or redundancy of the these exits has led to the need for this project whose objectives are to: (A) Determine performance of high-speed turn-offs at Canadian Airports; (B) Provide information as to why these turn-offs are not being used as effectively as anticipated; (C) Set forth an optimum and realistic design that will give more efficient aircraft ground movement from the runways to the taxiways.

SUPPORTED BY National Research Council of Canada

1.0005, AIRCRAFT TURBULENCE DATA

J.T. LEE, U.S. Dept. of Commerce, Environmental Research Labs., *Boulder, Colorado* 80302 (RC360802)

PROJECT OBJECTIVE: To update radar reflectivity-turbulence correlatives derived from 1962-1967 penetration flights by using data collected during the 1973-1977 penetration program.

CURRENT YEAR PLAN: Reduce aircraft turbulence data for the F-100 and F-4-C flights conducted in 1973 through 1977. Correlate these data with weather radar reflectivity parameters concurrent with the penetrations.

SUPPORTED BY U.S. Dept. of Transportation, Federal Aviation Admin.

1.0006, WIND TUNNEL INVESTIGATION OF THE AIRFLOW OF A MODEL HELICOPTER (ABBREV)

A.J. LANDGREBE, United Technologies Corp., *Hartford, Connecticut* 06108 (DA0F9013; DAAG29 77 C 0013)

To experimentally investigate helicopter rotor wakes for low forward speeds characteristic of current rocket firing tactics accounting for interference effects of the fuselage, wing, and the ground, and to utilize this data for determining analytically the velocity distributions along trajectories through the wake. Relevance -the research is directly relevant to the problem of a sight correction system on the AH-1G for the 2.75 in. rocket and to the problem of determining the correct position for a wind sensor. In addition, it is relevant to the determination of helicopter aerodynamic characteristics required in other investigations such as those associated with low-speed, terrain flying missions.

Rotor wakes produced by a combined model rotor-fuselage-wing will be examined and measured by means of both laser

velocimeter and visualization techniques for determining the wake velocities and geometries, respectively. The results of the experimental program will provide velocity and wake geometry data for correlation with theory and for a systematic determination of the effects of aircraft components, ground effect, and significant flight parameters.

SUPPORTED BY U.S. Dept. of Defense, Army Materiel Development & Readiness Command, Army Research Office

1.0007, RELIABILITY PREDICTION FOR COMBUSTORS AND TURBINES

B. SCHLEIN, United Technologies Corp., *Hartford, Connecticut* 06108 (DF458010; F33615-75-C-2057)

The objective of this program is to formulate a basic analytical and systematic statistical model for use in predicting aircraft turbine engine combustor and turbine life variations (reliability) as a function of mission cycle and uncertainties in the operating environment and design parameters. This basic system will appropriate supporting data and reliability analysis will be a practical tool for: (1) predicting component field life including mission performance/life trades during the design and development phases of an engine program, and (2) assessing the effect of operating mission variations and design parameter uncertainty on component life during service.

The contractor shall conduct a research program to accomplish the above objectives in the manner set forth in the following paragraphs. Phase I - the contractor shall determine or identify the most probable failure modes in the combustor and high-pressure turbine of current aircraft gas turbine engines. For each failure mode, two failure prediction models shall be developed or provided. The first shall utilize a statistical probability approach using failure-rate data or other appropriate data. The second model shall utilize the physics of failure approach. Throughout the prediction system development, these two models will be compared to each other to establish consistency and uncertainties in the prediction system. Each model shall be formulated such that it will stand alone and can be executed independently. Phase II - the contractor shall modify an available turbine engine mission analysis computer program to simulate the engine environment variations, performance degradation, engine transients and required mission history information for the life prediction models of Phase I. Phase III - the contractor shall calibrate the models of Phase I and Phase II and verify results with appropriate data. An analysis of the uncertainty of the life prediction scheme shall be conducted. Phase IV - the contractor shall assess the component relative life variations for typical current aircraft missions. Three representative alternate missions relative to a base mission shall be analyzed for both a transport and fighter/attack propulsion system. One mission from each application shall be used for study of the uncertainties of model parameters.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aero Propulsion Lab.

1.0008, ADVANCED COMPOSITE DESIGN PROGRAM

R.B. PIPES, Univ. of Delaware, School of Engineering, *Newark, Delaware* 19711 (DF138250; F33615-76-C-3126)

Advanced composite structures offer the potential of saving weight and cost on future military airframe structures, and will allow significant increases in aircraft performance (particularly range). The amount of payoff in weight and cost to be realized will depend on the efficiency of the design concepts used. One concept proposed by AFFDL/FB has outstanding promise for a tremendous payoff, but needs development before it can be introduced into production aircraft. This program will develop essential design information on this concept, which features spar caps embedded in composite wing skins.

This effort will investigate promising new concepts for attaching spars to skins in advanced composite wing structures. An existing fighter aircraft will be used as baseline, and the new concepts will be developed to meet the specific requirements of this baseline. Activities to be conducted include preliminary design, detailed design, component fabrication, and testing of the components. A final report will be published.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0009, STRUCTURAL INTEGRITY OF STORES AND STORE-AIRCRAFT INTERFACES

C.W. INGRAM, U.S. Air Force, Armament Laboratory, *Eglin Air Force Base, Florida* 32542 (DF626600)

To develop the in-house analytical and test capabilities to evaluate the structural integrity of stores, racks, pylons, and aircraft. These capabilities will be developed in a manner suitable for future efficient and timely application in a production environment.

The analytical capability development will involve two approaches. First, classical methods of stress analysis will be applied by the use of a stress manual. The stress manual will incorporate equations for geometric shapes, materials, and load sets encountered during design and evaluation of stores and store carriage equipment. Software for analysis of structural shapes frequently encountered during analysis (i.e., beams, fasteners, etc.) will be computerized using interactive terminals for a 'hands on' capability. Second, finite-element structural modeling software will be employed as an analytical tool. Computer programs using the finite-element method will be maintained in conjunction with auxiliary routines which increase input and output efficiency. Structural integrity evaluation by test methods will be initiated by the use of controlled environment testing (i.e., ADTC static loads facility). Stores and store-aircraft interface equipment will be statically loaded to verify structural integrity analyses done by purely analytical methods and determine the effects of flexibility in the subject structural system. Further evaluation will involve instrumented flight tests to determine load paths, effects of flexibility, and the structural integrity of the store-aircraft system.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Armament Lab.

1.0010, FREE STREAM DATA COLLECTION

V.S. OXFORD, U.S. Air Force, Armament Laboratory, *Eglin Air Force Base, Florida* 32542 (DF641560)

Air Force function - aircraft-stores compatibility. Opportunity -structural integrity and certification of stores on aircraft. Goal - to provide store free stream aerodynamic data in graphical, tabular, and magnetic tape form. How work contributes - allows for a quick and efficient means of obtaining data for use with MIL-A-8591E and for comparisons with stores in carriage.

The approach will be to first compile the existing available store free stream aerodynamic data, and then develop a data retrieval system which allows for access to the data through tabular, graphical, or magnetic tape form. The system will be updated to include new data as it becomes available.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Armament Lab.

1.0011, RAMBURNER INSULATION CONCEPTS AND EVALUATION

J. POTTS, Martin Marietta Corporation, *Orlando, Florida* 32805 (DF457090; F33615-75-C-2007)

The objectives of this program are first, to identify and test innovative, technically sound, approaches which would eliminate some of the problems caused by external aerodynamic heating of high-temperature ablative ramjet combustors. The most severe problem related to this heating is the premature pryolysis of the elastomer ablator at the elastomer/metal casing. This pryolysis generates gases which in turn cause bubble formation and hence bond failures. The second objective is to optimize an elastomer retention scheme for assisting in the retention of the ablator (both virgin and charred) or if technically feasible, the complete elimination of a retention scheme.

The use of vent holes to allow the escape of decomposition gases generated by external aerodynamic heating can hopefully be eliminated by using some new approach such as an external insulator and/or an internal insulation at the elastomer-casing interface. Other innovative, but practical, approaches for solving this problem should also be considered. The techniques chosen to solve the backside heating problem must be compatible with ex-

isting ramjet system requirements, and in addition, the effectiveness of the techniques chosen shall be demonstrated by fabricating and testing these techniques in sub-scale combustors with realistic internal and external aerodynamic and thermodynamic conditions. The minimum number of tests to be conducted shall include four baseline tests, i.e., two combustors without vent holes and two with vent holes, plus one test for each new concept; at least three new insulation concepts shall be evaluated. In-depth thermocouples in the elastomer should be included as part of the test instrumentation for these series of tests.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aero Propulsion Lab.

1.0012, COMPRESSOR RESEARCH FACILITY

J. UNTZ, Cadre Corporation, *Atlanta, Georgia* 30362 (DF455760; F33615-73-C-2030)

The objective of this program is to contribute to the advance of the state-of-the-art of turbine engine compressor technology by (1) supporting exploratory and advanced development of compressor design, (2) improve compressor component characteristics, (3) determine steady-state and dynamic air flow characteristics, and (4) determine effects of steady-state and transient air flow on compressor performance.

The approach is a three contract, turn key effort having five (5) phases. Phase I - detail design, phase II - equipment procurement, phase III - installation, phase IV - inspection and maintenance of existing equipment, phase V - test and inspection. AFAPL utilizes a 10 man team to monitor the program (see accession 455770 AFAPL in-house 30660412).

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aero Propulsion Lab.

1.0013, A STUDY OF TURBULENT FLOWS ABOUT OSCILLATING AIRFOILS 13100-E

J.C. WU, Georgia Inst. of Technology, School of Aerospace Engin., *Atlanta, Georgia* 30332 (DA0H5578; DAAG29 75 G0147)

To establish a general computational capability for the prediction of turbulent flow fields, which may involve appreciable flow separation and strong viscous-inviscid interaction, associated with finite bodies undergoing arbitrary motion at high Reynolds numbers. Relevance - this research is directly relevant to the AMRDL program of fundamental research on unsteady viscous flows and helicopter blade stall. It is also relevant to the problems of missiles penetrating the wake of another missile or the downwash of helicopter rotors both of which are of interest to MICOM.

The work will utilize the two-equation models of turbulence in conjunction with the integro-differential method of solution of the Navier-Stokes equations for treating the flow past oscillating airfoils at high Reynolds numbers.

SUPPORTED BY U.S. Dept. of Defense, Army Materiel Development & Readiness Command, Army Research Office

1.0014, VARIANCE IN FATIGUE CRACK PROPAGATION

B.M. HILLBERRY, Purdue University, Purdue Research Foundation, *Lafayette, Indiana* 47907 (DF138680; AF-AFOSR-3018-76)

The accuracy of crack life predictions required by USAF MIL-A-83444 depends on the accuracy of the constant amplitude crack growth rate data on which they, the predictions, are based. The objective of this effort is to relate the variance in fatigue crack growth rates to the variance in crack growth lives and thereby determine the accuracy required in describing constant amplitude fatigue crack growth rates. The return on this investment will be more accurate crack growth life prediction capability that can be utilized to establish aircraft structural safety and durability.

Constant amplitude fatigue crack growth rate data provide the analyst with the necessary baseline data for predicting crack growth lives. These baseline data are generated by numerical differentiation of descrete experimental crack length vs. cycles data points. This effort employs a systematic procedure for evaluating the variance in crack growth rate data due to (a) point-to-point material differences, (b) numerical differentiation techniques, and (c) crack length vs. cycle data collection techniques. Unless the variance due to each of these factors is evaluated, it is not possible to discern from the crack growth rate data potential variations in crack growth lives.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0015, ENERGY CONVERSION - STAGNATION REGION GAS FILM COOLING FOR TURBINE COOLING APPLICATIONS

B.A. REESE, Purdue University, School of Aero. Astr. Eng. Sci, *Lafayette, Indiana* 47907 (DN475466; N00014-75-C-0873)

The objective is to obtain accurate data on the local rate of convective heat transfer to a highly cooled surface exposed to an accelerated, highly turbulent hot gas flow, with particular emphasis on the influence of turbulence scale and intensity and unsteady effects on stagnation region film cooling. The effort is primarily experimental, with analytical modeling backup, and is aimed at optimizing engine performance while utilizing higher turbine inlet temperatures with necessary cooling schemes. The research contributes to increasing the performance of aircraft and marine gas turbine engines.

A two-dimensional rectangular flow channel, with heated air from a gas turbine combustor supplied to a cylindrical film cooled test surface is used to model the turbine vane leading edge. This is being modified to include multiple rows of film coolant holes.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

1.0016, DEVELOPMENT OF HARDWARE AND METHODOLOGY TO IMPLEMENT THE PAVEMENT DEFLECTION BASIN METHOD OF NONDESTRUCTIVE TESTING

UNKNOWN, Purdue University, Graduate School, *Lafayette, Indiana* 47907 (FA77WA-3982; FA160075 (TRAIS NO.))

Develop a portable, self-contained device, that can be fastened onto a test vehicle and provide continuous and periodic deflection profile data under actual vehicular loadings. Testing shall be accomplished rapidly over all surfaces of interest under non-contact nondestructive conditions. The data shall be stored on magnetic tape and shall be submitted to a computer for analysis.

SUPPORTED BY U.S. Dept. of Transportation, Federal Aviation Admin.

1.0017, TORSION-FREE WING FLUTTER RESEARCH

H.T. YANG, Purdue University, Purdue Research Foundation, *Lafayette, Indiana* 47907 (DF047920; AF-AFOSR-3265-77)

AF function - development of new wing concepts can improve aircraft performance. Deficiency - incomplete understanding exists as to the flutter characteristics of a torsion-free wing concept. Objective -objective of the research is to develop basic insight into the flutter mechanisms which govern the behavior of a torsion-free wing. How work contributes - research supports new concepts for improvement of aircraft.

Analysis of three torsional free wing (TFW) models previously tested by AFFDL will be conducted using the finite-element method and doublet lattice aerodynamics. These models are (1) cantilever wing, (2) pitch restrained wing, and (3) TFW with aft trim surface. The analysis will establish the basic computation methods for free vibration and flutter of each model. Further, the analysis will study trends of the model and sensitivity of parameters, such as location of pivot shaft and trim surface, and bending and torsional stiffness of the boom.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

1.0018, BALLISTICS TECHNOLOGY - AIRCRAFT ARMAMENT SYSTEMS AND SURVIVABILITY
D.F. HASKELL, U.S. Army, Ballistic Modeling Division, *Aberdeen Proving Ground, Maryland* 21005 (DA0P4450)

To develop an Army Aircraft Armament System Analysis Model (ASSAM) and techniques for increased survivability of Army aircraft.

A helicopter armament system engineering model will be developed. This model will be composed of an integrated set of submodels and will be capable of evaluating armament systems' effectiveness. It will tie together weapon interior, exterior, and terminal ballistics with fire control, aircraft flight control, aircraft structural dynamics response, and armament system lethality. Means to increase helicopter survivability will be studied. The effect of future composite materials on helicopter structural vulnerability reduction will be assessed. A truss-type helicopter tail boom will be designed, fabricated, and tested. In addition, a technique for the optimum design of helicopter structures for vulnerability reduction will be developed.

SUPPORTED BY U.S. Dept. of Defense, Armament Research & Development Command, Ballistic Research Labs.

1.0019, HINGE MOMENTS OF AN OPTIMIZED CONTROL SURFACE DESIGN
J. GRECO, Raytheon Company, *Bedford, Massachusetts* 01730 (DF139760; F33615-77-C-3029)

A number of current and future missile systems utilize tail control surfaces to produce the required stabilization and control. For high Mach number flight, the tail size requirements of each function are not complementary. The large surface area needed for stability is more than that required for control. The split tail concept to be investigated will optimize the tail design yielding greater aerodynamic and control system efficiency. Also, it is anticipated the concept will result in a significant reduction of hinge moments which will allow utilization of lighter weight, smaller size, and lower cost actuators.

Although limited theoretical analyses have been performed, the effects of the visuous separated flow interaction between the control surfaces can only be accurately investigated experimentally. A body-tail configuration will be tested at low and high supersonic Mach numbers and six-component model loads and control surface loads will be measured. This data will be used to determine the degree of optimization of the tail surface design and the associated hinge moments. Design charts will be prepared describing the performance of the split tail concept.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0020, DEVELOPMENT OF THE OCV, PART III
M. RUDD, Bolt Beranek & Newman Inc., *Cambridge, Massachusetts* 02138 (DF140940; F33615-77-C-3012)

Current airspeed indicating systems for military aircraft are accurate to a minimum speed indication of 50 knots (approx). Present sensing system errors in the low speed range are significant and are of sufficient magnitude to cause safety of flight problems when hovering or approach to land for V/STOL vehicles. The objective of this study is to further develop the optical convolution velocimeter, examine operational suitability and equipment environmental requirements, and test the device. The device is to be capable for accurate sensing and displaying of airspeed in the range of V/STOL-type aircraft.

The Air Force Flight Dynamics Laboratory has been developing various time-of-flight sensing techniques for velocity measurement. Of particular promise on the effort is the optical convolution velocimeter. This device has been patented. Dr. M. Rudd of BB&N has developed appropriate theory for single sensor detector, and has designed, fabricated, and tested a prototype unit. The approach is to proceed with further development with a) examination of environmental requirements for such a device, b) improvement of operational characteristics and c) test and evaluation. Three prototype units will be designed, fabricated, and tested. This approach has been suggested in an unsolicited proposal by Bolt, Beranek and Newman, Inc., of Cambridge, MA.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0021, FLAMEHOLDER COMBUSTION INSTABILITY STUDY II
E.R. NORSTER, Northern Res. & Engin. Corp., *Cambridge, Massachusetts* 02139 (DF460120; F33615-76-C-2112)

To conduct a combined analytical and experimental research effort to determine the effects of flameholding, flame stability, and related heat release phenomena in afterburners to determine or recommend designs which control or eliminate conditions that lead to low-frequency augmentor combustion instability.

This dual award to Northern Research and Engineering Corporation shares an SOW task with Pratt and Whitney, FRDC, to concentrate on the effect of heat release phenomena on rumble in turbofan afterburners. A companion contract awarded to P&W, FRDC, deals with the rumble problem in afterburners as a whole.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aero Propulsion Lab.

1.0022, AIRCRAFT LUBRICANT VISCOSITIES AT HIGH PRESSURE
B. NEWHALL, Harwood Engineering Co. Inc., *Walpole, Massachusetts* 02081 (DF459370; F33615-76-C-2053)

Develop the capability for measuring lubricant viscosities in the pressure and temperature range of interest in engine applications (200-300 Kpsi, 300-400 degrees F) and the viscosity range of importance to viscoelastic effects (100,000 cpoise and above).

Design and construct high-pressure viscometer cell for extreme pressures and modify existing measurement techniques to allow measurement of desired viscosities in a reasonable time period. Demonstrate equipment capability by conducting viscosity measurements on 2 fluids at critical pressures.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aero Propulsion Lab.

1.0023, SMOOTHNESS ANALYSIS
W.J. HORN, U.S. Army, Waterways Experiment Station, *Vicksburg, Mississippi* 39180 (DA0M8181)

The objectives are: (a) to define the surface smoothness requirements for new military airfield pavement construction, and (b) to develop methodology for the evaluation of the smoothness condition of existing Army airfield pavements.

Data analysis of the measured B-52 response data and the associated computer simulation studies will be completed and the initial surface smoothness construction criteria will be developed. Representative aircraft will be selected from the various classes of military aircraft. Computer simulation studies will be performed using the representative aircraft with real and hypothetical runway profile inputs to determine the influence of profile amplitude and frequency on aircraft response. The initial smoothness criteria developed earlier in the study will be examined with regard to the smoothness requirements for the range of military aircraft and revised where appropriate. The results of the AFWL smoothness evaluation studies will be used to develop an evaluation methodology for Army airfield pavements.

SUPPORTED BY U.S. Dept. of Defense, Office Chief of Engineers, Corps of Engineers

1.0024, DIGITAL DATCOM EXTENSION PROGRAM OF AIRCRAFT STABILITY AND CONTROL
J.E. WILLIAMS, McDonnell Douglas Astro. Co., *St. Louis, Missouri* 63166 (DF134480; F33615-75-C-3043)

Rapid and inexpensive methods for predicting the aerodynamic stability and control characteristics of Air Force weapon systems are needed. The availability of these methods will lead to better aircraft designs by permitting rational trade-offs to be considered early in the design. The objective of this work unit is to extend the capability which now exists in the USAF stability and control digital DATCOM by (1) permitting the program to accept a greater variety of configuration types and (2) extending the range of flight conditions at which predictions are possible and (3) reducing analysis time by simplifying input.

Digital DATCOM now requires, as input, the 2-dimensional aerodynamic characteristics of the airfoil sections of each lifting surface. Automated prediction of these characteristics will be incorporated into the program. The experimental data substitution option of the program now permits substitution of experimental characteristics for which DATCOM predictions are available. Therefore, experimental data can now be used to improve accuracy but not to extend the applicability of the methods. Methods will be programmed which will use empirical characteristics (for which prediction methods do not exist) as a base to provide predictions over an expanded range of flight conditions and configuration types.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0025, TRANSONIC UNSTEADY WIND TUNNEL MEASUREMENTS ON AN OSCILLATING WING WITH TIP STORES

H. TIJDEMAN, Natl. Aerospace Laboratory, *Amsterdam, Netherlands* (DF140100; AF-AFOSR-3233-77)

This work unit supports the aeroelastic evaluation of high-speed aircraft. It will contribute to the development of improved unsteady aerodynamic methods to predict aircraft aeroelastic stability and structural dynamic response. The goal is to conduct unsteady aerodynamic tests on oscillating models in transonic wind tunnels, resulting in ultimate savings in the costs to design new aircraft. The capability to make these measurements will allow the orderly development of necessary analytical methods to optimize aircraft structures for minimum weight and cost.

The proposed effort is to perform transonic unsteady wind tunnel measurements on an oscillating wing with external stores. The objective is to obtain experimental data to guide improvements in transonic unsteady theories which will be used to ascertain flight safety of future air-combat fighters with respect to wing flutter.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0026, MULTIFUNCTION FLIGHT CONTROL SENSOR

R. PITTMAN, Applied Devices Corporation, *Smithtown, New York* 11787 (DF135760; F33615-75-C-3154)

Low-cost multifunction sensor packages (MSP) for remotely piloted vehicles (RPV) currently do not exist. To acquire the many control parameters needed for RPV control, a variety of sensor packages, many developed for other applications, are used. This approach has resulted in excessive control system weight, complexity and acquisition cost with corresponding disadvantages incurred in high life cycle costs. The objective of this effort is to develop a low-cost multifunction control sensor package whose functional, physical and economical requirements are dictated by RPV mission requirements. This multi-sensor would replace a number of single-output sensors adapted from aircraft use which may be either over-designed or under-designed for RPV applications.

The MSP shall be designed to measure characteristics of the vehicle environment and its state including earth's total magnetic field, earth's total electrostatic field, air data, angular rates and linear accelerations. The sensor package shall have the versatility of being used in either a gimbaled or strapdown configuration. Where practical the MSP components are to be modular and fabricated of plastic using injection molding techniques. The fabrication approach shall result in a MSP that will satisfy a variety of vehicle and mission requirements without sensor redesign. Limited flight and laboratory evaluation shall be accomplished to verify soundness of the technical approach.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0027, PRELIMINARY DESIGN OF A COMPOSITE WING FOR NAVY V/STOL PROTOTYPE

O.G. ACKER, Rockwell International Corp., *Columbus, Ohio* 43216 (DN581067; N62269-74-C-0577)

To advance fibrous composite aerospace structures technology by the preliminary design of a major structural component representative of new fighter aircraft and to provide the basis for advanced development efforts to demonstrate the practicality of such structures. To support the Navy V/STOL prototype program by focusing on the preliminary design of a lightweight, highly reliable wing assembly with sufficient similarity to the final systems configurations to minimize transition from development to production status. To provide the technical basis, the economic analysis, and (by demonstration) the confidence needed for large-scale commitment of composites to future Navy aircraft structures. This work is in support of work unit ZA101, aircraft technology, agency accession no. 681080.

Conduct the preliminary design of a full-scale composite wing structure forward of the augmentor for the XFV-12a V/STOL fighter attack prototype. Fabricate one structural test specimen representing this structure between wing stations 0 and 79. 5.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Air Development Center

1.0028, APPLICATION OF COHERENT ANTI-STOKES RAMAN SCATTERING TO LASER & COMBUSTION MEDIA

B.R. WON, Systems Research Labs. Inc., *Dayton, Ohio* 45432 (DF461250; F33615-77-C-2019)

Use coherent anti-Stokes Raman scattering (CARS) for measuring specie concentrations and temperature as a function of position inside a jet engine combustor.

Use the CARS system already demonstrated to obtain spectra for organic compounds found in fuels and combustion products, use CARS to determine specie concentrations vs. position within a combustion system.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aero Propulsion Lab.

1.0029, DESIGN AND ANALYSIS OF ADVANCED STRATEGIC AND TACTICAL MILITARY AIRCRAFT EXHAUST NOZZLE SYSTEMS

D.L. BOWERS, U.S. Air Force, Flight Dynamics Lab., *Dayton, Ohio* 45433 (DF132000)

The broad problem area of advanced turbojet/turbofan powered military tactical and strategic aircraft is the losses in range and performance attributed to airframe/exhaust nozzle flow interactions. The problems associated with the exhaust system integration have become quite complex for aircraft required to perform efficiently both subsonically and supersonically. The objective of this study is to develop new analytical and design techniques, and to improve available analytical methods that will predict the installed performance of jet exhaust nozzles on advanced strategic and tactical military aircraft.

Improve the calculation of installed exhaust nozzle performance of advanced military strategic and tactical aircraft by improving current and developing new analytical techniques for calculating nozzle internal and external flow fields. Existing experimental data and additional experimental data generated in the AFFDL trisonic gasdynamics facility, AEDC PWT facilities, and NASA facilities will be utilized to develop empirical criteria for exhaust nozzle design.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0030, ADVANCED REMOTELY PILOTED MODULAR AIRCRAFT (ARPMA) STUDIES

D.R. BURNETT, U.S. Air Force, Flight Dynamics Lab., *Dayton, Ohio* 45433 (DF133700)

Advanced operational multi-mission remotely piloted vehicles (RPVs) must have the capability to perform several different missions, employing vastly different special mission equipment. This requirement necessitaties an airframe of modular design to accommodate rapid interchange of aerodynamic surfaces, launch and recovery equipment, and primary mission equipment modules. The objective of this program is to perform conceptual design studies leading to the design of an advanced modular technology demonstrator RPV.

Special emphasis will be placed on the application of the principle of modularity to both the total airframe, and to each subsystem. This will promote interchangeability of major structural components as well as subsystems components. Two parallel contracted efforts will be employed to support the in-house study in FY 75.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0031, AERODYNAMIC ANALYSIS ON CAVITIES, 2-D AND AXISYMMETRIC BODIES

W. CALARESE, U.S. Air Force, Flight Dynamics Lab., *Dayton, Ohio* 45433 (DF138570)

A significant problem area of high-performance military tactical and strategic aircraft are the range and performance losses due to airframe-exhaust nozzle flow interactions. These losses are more significant in the transonic regime where nonlinear effects produce drag forces beyond tolerable limits. High drag and turbulence are also produced by open port turrets necessary for the use of such equipment as telescopes. The objective of this investigation is to develop a theoretical approach capable of analyzing the transonic and supersonic flow field over 2-D airfoils and bodies of revolution including jet plume, Reynolds number effects, shock-boundary layer interactions, boattail injection, and viscous mixing in separated regions, to provide quiet environment behind an open port, to minimize optical distortion and attenuation along a line of sight through the open port to some external point, to study laser exhaust flow and to obtain an overall drag reduction.

Numerical techniques, i.e., relaxation and/or time dependent, will be used to solve the transonic inviscid flow field. Boundary layer properties, jet plume effects, and mixing will be calculated with appropriate methods and incorporated in the solution. A computer program will be developed. Experiments will be performed in-house in the 2 ft tunnel over an already existing ogive-cylinder model with a metric porous boattail which allows mass injection, and with a plume simulator. Jet plume and Reynolds number effects on boattail and base drag will be checked, shock location and shock-boundary layer interaction will be analyzed as functions of boattail mass injection. Experimental wind tunnel tests will be conducted to achieve afterbody drag reduction by mass injection and to determine the magnitude and frequency of flow directions and various cavity geometries. Porous boattails, fairings, spikes, deflectors, and spoilers will be used to improve the external flow pattern and reduce drag and density gradients throughout the speed regimes.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0032, HIGH-SPEED INSTRUMENTATION FOR GENERATOR TEST FACILITY

E.J. CAPUTO, U.S. Air Force, Aeropropulsion Laboratory, *Dayton, Ohio* 45433 (DF458970)

Complete the AFAPL generator test facility by providing a data acquisition and control system with the following capabilities: (1) sufficient acquisition speed to characterize aircraft electrical system transient performance, (2) storage of all performance-related test data, (3) short time playback and analysis capability, (4) complete automation, and (5) engine start simulation.

Design system and procure and integrate all necessary components to accomplish objective. System will be composed at a MODCOMP II computer, a high-density digital tape drive, 18 10-microsecond conversion a/d converters, and necessary interfacing and control circuitry. The MODCOMP II will be a satellite in the AFAPL computer network.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aero Propulsion Lab.

1.0033, AIRBORNE MEASUREMENT OF LIGHTNING ENVIRONMENT AND STUDIES OF INDUCED EFFECTS IN AIRCRAFT

J.T. DIJAK, U.S. Air Force, Flight Dynamics Lab., *Dayton, Ohio* 45433 (DF140270)

Obtain airborne electric and magnetic field measurements of the nearby lightning environment to characterize the threat, obtain measurements of skin currents and induced transients within the aircraft while operating in a lightning environment, obtain a correlation between airborne and ground lightning test measurements, and obtain and apply a computer program model of the lightning-aircraft interaction sufficient to predict induced transients on subsystems, and validate results by comparison with measured data. Newer air force aircraft are using electronic subsystems that are increasingly vulnerable to lightning induced transients.

A NASA learjet aircraft will be instrumented to measure the external magnetic and electric field environment due to lightning as well as internal induced transients. The aircraft will be flown as part of the Thunderstorm Research International Program (TRIP) hosted by Kennedy Space Center during July and August 77 in the vicinity of the thunderstorms and lightning to gather data. A ground simulated lightning test will then be performed on the instrumented aircraft, and all the observations will be correlated with those made under actual lightning conditions. A computer program chosen from among existing EMP simulation models will be adapted to model the aircraft-lightning interaction for this case, data obtained during the airborne and ground test phases will be used to validate and assist in the generation of the computer algorithm.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0034, ADVANCED FIRE, EXPLOSION AND OVERHEAT DETECTION CONCEPTS FOR AIRCRAFT

D.G. FOX, U.S. Air Force, Aeropropulsion Laboratory, *Dayton, Ohio* 45433 (DF451630)

To select a multiplexing technique, pulse code modulation (PCM), pulse amplitude modulation (PAM), etc., and determine the most optimum method for using all available hazards sensors to inform crew members of the type, location and size of hazard and what should be done about it. To directly digitize and address transducers so that interrogation by the multiplexer can be direct and efficient. A flight qualified system capable of providing rapid collated instructions and information to crew members is the goal of this program.

Select an optimum multiplex technique for aircraft use. Purchase an off-the-shelf unit for testing having the qualifications defined above (number of words, clock frequency, number of bits in a word, etc.). Analyze available transducers for the direct application to the multiplexer and design new electronics as required. Analyze hazardous areas to determine information and sensor requirements. Build final unit.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aero Propulsion Lab.

1.0035, NEAR-TERM ADVISORY FOR WAKE TURBULENCE

D.R. GEE, U.S. Air Force, Flight Dynamics Lab., *Dayton, Ohio* 45433 (DF137450)

Wake turbulence is an increasing hazard as noted by an increase in aircraft accidents/incidents attributed to wake vortex encounters. The objective of the near-term advisory for wake turbulence is to establish new minimum safe separation standards between aircraft in a high aircraft density environment, resulting in a maximum utilization of existing airfields (fuel conservation) and a reduction of aircraft accidents/incidents. The present separation standards address only heavy aircraft (over 300,000 pounds gross weight) in civilian operations. Mid-air refueling, minimum interval takeoff (M.I.T.O.), and formation flight are unique to the Air Force. These flight regimes have not been explored with reference to wake vortex encounter.

The approach to the near-term advisory is to utilize existing computer methods for computing the vortex wake generated by operational USAF aircraft. These aircraft are then to be categorized by their respective wake strengths. Once completed the various category representative aircraft will be analyzed in the vortical wakes of each other. The data is to be combined into a minimum safe separation standard. M.I.T.O., mid-air refueling, formation and high-density landing environments will be studied individually with high traffic density landings having priority.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0036, HIGH-PERFORMANCE MHD FOR AEROSPACE HIGH POWER

J.F. HOLT, U.S. Air Force, Aeropropulsion Laboratory, *Dayton, Ohio* 45433 (DF455410)

To experimentally and analytically investigate means of delivering 20 to 100 kilovolts at power levels of 100 kilowatts and upward, from open cycle MHD combustion generators.

Computer programs will be operated for the purpose of comparing experimental performance with theory. Five-second power runs will be conducted with a one-meter long MHD channel. This channel will be coupled to a 2 KHZ dc-dc converter that will be tested for producing 30 KV and 50 KV outputs. The problems involved in producing high-voltage power by this means will be reported. A fast scanning data system will be operated so as to record 100 data channels as a function of time during the runs. Processing machines and programs will be employed in plotting or interpreting the data. A diagonal conducting wall channel will be operated for test each of durations in range 1 sec to 1 minute. Bursts of power will be generated through keying the combustor controls to apply bursts of combustion plasma. Relationship of angle diagonal wall interconnections of a peg wall channel to power output will be investigated.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aero Propulsion Lab.

1.0037, DEVELOPMENT OF HEATED AIRFRAME DESIGN CRITERIA FOR STRATEGIC AND TACTICAL AIRCRAFT

D.B. PAUL, U.S. Air Force, Flight Dynamics Lab., *Dayton, Ohio* 45433 (DF129190)

Strategic and tactical aircraft with supersonic to hypersonic speed capability need detailed design requirements in military specifications and adequate airframe load prediction techniques to account for the effects of aerodynamic heating upon flight vehicle airframes. Current military specifications (MIL-A-8860 series) do not delineate adequate requirements for airframe design under aerodynamic heating, and the AFSC design handbooks do not outline proper procedures to structurally account for heating effects. This effort will develop essential heated airframe design criteria and the associated load prediction techniques to account for the structural effects of aerodynamic heating on military aircraft.

Develop and refine in-house heated structure analysis techniques with emphasis on advanced heated airframes, but with possible application to other heated structures (such as radomes and propulsion systems). Establish, where necessary, computer programs to aid structural design engineers. Implement, where applicable, proven techniques into the AFSC design handbooks and the USAF structural design criteria specifications.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0038, APPLICATION OF CATALYTIC COMBUSTION TO GAS TURBINE ENGINES

T.J. ROSFJORD, U.S. Air Force, Aeropropulsion Laboratory, *Dayton, Ohio* 45433 (DF458230)

The objective of this work unit is to investigate the application of catalytic combustion to the primary combustor and afterburner of gas turbine engines. Goals of improved combustion performance and low exhaust emissions over the entire operational range of these components will be pursued.

Previous investigations have substantiated the feasibility of catalytic combustion at conditions simulating high-power operation of a gas turbine engine. This program will expand the data base for catalytic combustion in both low- and high-power modes through experimental investigations conducted in Room 20, Bldg 18C (see work unit 30480542). The ability of a catalyst to ignite and promote the combustion of a fuel/air mixture in an afterburner will be experimentally investigated in a J85 gas turbine engine mounted on test stand C, Bldg 71A (see work unit 30660532). To expand the basic knowledge of catalytic combustion processes, a fundamental research program will investigate the surface reactions on a catalytic flat plate in a combustion tunnel installed in Room 20, Bldg 18C (see work unit 30480542).

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aero Propulsion Lab.

1.0039, SUPERCONDUCTING GENERATOR FOR AIRBORNE HIGH-POWER APPLICATIONS

J. PARKER, Westinghouse Electric Corp., *Lima, Ohio* 45802 (DF452320; F33615-71-C-1591)

Development and test of a lightweight megawatt class superconducting ac generator. The program will demonstrate the feasibility of high-power superconducting generators for airborne applications.

The program consists of three phases: (1) analyses, preliminary design and critical component test--full-scale rotor test, seal tests and superconducting material tests will be accomplished in this phase; (2) extended seal and rotor testing, detail design and machine checkout; (3) phase III contains performance verification tests two 24 hour test of continuous operation at 1 mva with 0.8 pf lagging and 10 second pulses of 5 mva. At least 10 pulses will be imposed during each 24 hour run. Duration between pulses will be 1 - 3 minutes.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aero Propulsion Lab.

1.0040, REVERSE VELOCITY ROTOR CONCEPT

H.N. STUVERUDE, Boeing Company, *Philadelphia, Pennsylvania* 19142 (DN590188; N00019-76-C-0436)

To assess the reverse velocity rotor (RVR) configuration, an advanced rotary concept, against the projected Navy/Marine Corps requirement for replacement of the current SH-3 ASW and CH-46 medium assault helicopters. Technology levels will be consistent with an initial operating capability (IOC) date between 1981 and 1984.

Using the government-furnished data base generated under Navy contract N00019-75-C-0522, the contractor will design an RVR high-speed helicopter. Sensitivity of the vehicle designs to variations of the primary inputs to the design study will be explored. The contractor will also assess the risk of improving those inputs which hold the most promise for a lighter gross weight.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Air Systems Command

1.0041, ADVANCED STRUCTURAL DESIGN

R.M. LASALLE, General Dynamics Corporation, *Fort Worth, Texas* 76101 (DF139510; F33615-77-C-3042)

Advanced composites exhibit considerable potential for performance and cost benefits in primary airframe members of Air Force aircraft. The problem lies in generating efficient, reproducible, low-cost structural configurations responsive to the unique characteristics of advanced composites and the requirements of military airframes. The objective of this program is to generate and validate a new design concept for advanced composite wings for fighter-type aircraft incorporating a new approach for manufacturing the lower skin and interior spars to improve structural efficiency and reduce life cycle costs of composite airframe construction. Demonstration of the structural integrity of the conceptual configuration proposed along with system effectiveness and economic analysis will provide future airframe designers with an efficient, economic alternative for advanced military aircraft.

A wing box demonstration article that models the same identical portion of the F-16A wing as that modeled in the advanced metallic laminated wing structures program, contract F33615-75-C-5178, will be designed of advanced composites incorporating imbedded spar cap features which can provide significant cost reductions over conventional mechanically fastened composite structure. Critical elements of this design configuration will be evaluated by a series of element tests. Fabrication of these structural elements will provide an opportunity for preliminary assessment of manufacturing methods and costs for use in

comparing with production hardware and advanced configurations being studied under contract F33615-75-C-5178.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0042, THREE-DIMENSIONAL PHOTOELASTIC ANALYSIS OF SURFACE FLAWS

C.W. SMITH, Virginia Poly. Inst. & St. U., School of Engineering, *Blacksburg, Virginia* 24061 (DF136910; F33615-76-C-3078)

Structural safety and current and future USAF tactical and strategic aircraft is a continuing problem. To insure that prescribed levels of safety are achieved for individual aircraft, methods must be developed to determine the basic characteristics and behavior of cracks in load bearing structures. Analytical methods have been developed for this purpose but have little or no data to verify their accuracy in three-dimensional solid bodies. This effort is to develop a technique for getting this data and to examine different crack configurations.

Three-dimensional photoelastic techniques will be developed to get crack tip stress intensity factors for a variety of surface flaw geometries.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0043, A COMPREHENSIVE STUDY OF AIRCRAFT GAS TURBINE ENGINES

G. OATES, Univ. of Washington, School of Engineering, *Seattle, Washington* 98105 (DF040270; AF-AFOSR-2783-75)

AF function - improved turbomachinery. Opportunity - increase our understanding of the operation of a modern gas turbine. Objective -prepare a report containing an advanced and comprehensive description of the fundamental theory, performance and aerodynamics of modern aircraft gas turbine engines. How work contributes - will provide insight into effect of component performance on overall engine performance.

The report will be divided into two general areas. The first area will deal with basic thermodynamics and fluid flow concepts of modern gas turbine engines. The second area will deal with specific advanced topics and will be written by specialists in the field.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

ASTRONAUTICS

Includes Astronautics (general); Astrodynamics; Ground Support Systems and Facilities (space); Launch Vehicles and Space Vehicles; Space Transportation; Spacecraft Communications; Command and Tracking; Spacecraft Design, Testing, and Performance; Spacecraft Instrumentation; and Spacecraft Propulsion and Power. For Related Information See Also Aeronautics.

2.0001, SPACECRAFT CHARGE MODELING

L.W. PARKER, Lee W. Parker Incorporated, *Concord, Massachusetts* (DF246820; F19628-76-C-0248)

AF function - space systems survivability. Deficiency - inadequate knowledge of the interaction between the energetic particle environment at synchronous orbit altitudes and the potential field of a charged satellite is detrimental to the design of future space systems. Objective - a theoretical investigation of the interaction between a high-temperature plasma and the potential distribution that exists in the vicinity of a charged satellite. How research contributes - the complexity and sophistication of present and future defense satellite systems has resulted in a greater susceptibility of these systems to environmental disturbances. Rapid changes in the fluxes of energetic plasma particles incident on a highly charged satellite can induce large transient currents which pose a threat to satellite components. Understanding the potential field of a spacecraft and identification of the conditions that yield the damaging transient currents is critical to future satellite design.

Computer techniques and models are developed to simulate the interaction of idealized spacecraft sheaths and an energetic plasma environment. Particle trajectories through the plasma sheath are studied in order to understand the interaction between the satellite potential field and the ambient plasma. Working in cylindrical coordinates various combinations of satellite surface properties are modeled and the relative effects of these combinations are analyzed to determine the ultimate potential configuration.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

CHEMISTRY AND MATERIALS

Includes Chemistry and Materials (general); Composite Materials; Inorganic and Physical Chemistry; Metallic Materials; Nonmetallic Materials; and Propellants and Fuels.

3.0001, LOW EXHAUST SIGNATURE PROPULSION

W.W. WHARTON, U.S. Army, Radar Technology Laboratory, *Huntsville, Alabama* 35809 (DA0F1081)

To develop propellants with low smoke content and with improved properties, particularly service life and burning rate improvements in the region of 0.7 to 1.5 inches per second.

The approach is to investigate the crosslinked double base propellants, particularly those containing hmx replacement of nitroglycerin and using inert binders.

SUPPORTED BY U.S. Dept. of Defense, Missile Research & Development Command, Propulsion Directorate

3.0002, WEAPONRY - HIGH-ENERGY HALOGEN CHEMISTRY LEADING TO THE SYNTHESIS AND CHARACTERIZATION OF NEW INGREDIENTS FOR PROPELLANTS AND EXPLOSIVES

K. BAUM, Fluorchem Incorporated, *Azusa, California* 91702 (DN123215; N00014-71-C-0176)

New or improved rocket propellants are needed for the propulsion systems of Navy vehicles for tactical and surveillance missions in the atmosphere and nearby space. This task seeks chemical knowledge leading to the synthesis and characterization of new high-energy propellant ingredients and of new chemical explosives.

These investigators, from an established background in perchlorate, nitro, and difluoramino organic chemistry and the employment of elemental fluorination, will seek to apply this knowledge toward compounds with improved properties such as hydrolytic stability. Nitro groups or difluoramino groups will be associated with the perchlorate group to optimize properties. The reactivity of new compounds will be studied from both the point of view of stability and utility as reagents. Synthesis of organo fluoro-dinitro siloxanes will be initiated to incorporate high-energy potential in compounds with low glass transition temperatures and phosphazenes.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

3.0003, WEAPONRY - CROSSED MOLECULAR BEAM STUDY OF THE REACTIONS OF OXYGEN AND FLUORINE ATOMS WITH FREE RADICALS AND MOLECULES

Y.T. LEE, Univ. of California, School of Letters & Science, *Berkeley, California* 94720 (DN223800; N00014-75-C-0671)

The technical objective of this research is to advance our understanding of the kinetics of chemical reactions relative to combustion and missile plumes. These are of direct relationship to the Navy for advancement of missile and aircraft propulsion, chemical lasers, processes occurring during reentry, and atmospheric reaction of pollutants.

The crossed molecular beam technique will be used to investigate the reactions of oxygen and fluorine atoms. The velocity of the oxygen atoms generated by microwaves or photochemically, will be controlled by the molecular weight of carrier gas and expansion conditions in a nozzle beam. The beam of atoms will react with a crossed beam of selected free radical or molecular species including methyl, methylene, and hydroxyl. The products are to be measured by a rotating mass spectrometer detector which scans angular and velocity distribution. A dedicated minicomputer is to be used for on-line data processing.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

3.0004, LOW-EXPANSION COPPER ALUMINOSILICATE GLASSES AND GLASS-CERAMICS

J.D. MACKENZIE, Univ. of California, School of Engin. & Appl. Sci., *Los Angeles*, *California* 90024 (NCA 2-390803)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

3.0005, CHEMICAL PHYSICS OF CHARGE MECHANISMS IN NONMETALLIC SPACECRAFT MATERIALS

J.E. NANEVICZ, S R I International, *Menlo Park*, *California* 94025 (DF048670; F49620-77-C-0113)

AF function - operational and future Air Force space systems are required to perform their missions in extreme service environments. Deficiency - the interaction of a synchronous-orbit satellite with its environment activates electrification and electrical discharge processes producing electromagnetic noise pulses and effluents which deteriorate satellite materials, surfaces and components. Objective - the objective is to perform research to understand the mechanisms underlying spacecraft charging in polymeric and other nonmetallic dielectrics. How work contributes - it is expected that this research will contribute to the establishment of guidelines for the design and modification of satellite materials which are not degraded by the effects of electrical charging and which will minimize disruptions in Air Force space systems mission performance.

(a) Study nature, causes and effects of charging and discharging processes in typical spacecraft polymers and other non-metallic dielectrics under orbital conditions, (b) deter physics of critical electrostatic charging phenomena and properties of materials that affect electrostatic charging properties, and (c) study methods for modification of materials properties to improve their in-space performance characteristics.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0006, SYNTHESIS OF PHOSPHATRIAZINES FOR POTENTIAL HIGH-TEMPERATURE FLUIDS APPLICATIONS

K.L. PACIOREK, Ultrasystems Incorporated, *Newport Beach*, *California* 92660 (DF043280; F44620-76-C-0065)

Air Force function - future Air Force flight operations require better environment resistant materials. Deficiency - a need exists for fluids and lubricants with better high-temperature stability than presently existing materials. Objective - the objective of this research is to synthesize and characterize new polyfluorinated compounds with high thermal and oxidative stability. How work contributes - the work will determine the usefulness of the newly synthesized materials in high-temperature applications.

Research will be performed to establish methods and conditions for the synthesis of mono- and di-phospha-s-triazines which are substituted symmetrically by perfluoroalkyl or perfluoroalkylether groups. To allow a comparative study of properties and the mechanisms of formation, transformation, and degradation in the series, the analogously substituted s-triazines and triphospha-s-triazines will also be included.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0007, INVESTIGATION OF CONTROLLED NUCLEATION THERMOCHEMICAL DEPOSITION (CNTD) MECHANISM AND PROPERTIES

R.A. HOLZL, Chemetel Corporation, *Pacoima*, *California* 91331 (DF047780; F49620-77-C-0086)

AF function - ceramic materials are being developed for a variety of components (e.g., blades, vanes, combustors, bearings and seals) in future gas turbine engines and for a variety of electronic and optical components in aircraft. Opportunity - a new CVD-like process known as CNTD (controlled nucleation thermochemical deposition) has been developed for producing very fine-grained materials having superior mechanical properties. Objective - the objective of this research is to study the mechanism and deposition parameters of CNTD for fine-grained high-strength silicon carbides. How work contributes - silicon carbide and silicon nitride filaments, films and monolithic shapes are needed for rocket nozzles, turbine components, and radome applications. Silicon carbide was selected for the initial studies in order to utilize the extensive experience in conventional vapor deposition of sic.

The optimum deposition parameters for CNTD will be established to produce fine-grain, high-strength SiC. Microstructure and mechanical testing data will be used in an iterative development cycle for optimizing the process.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0008, MECHANICS OF COMPOSITE MATERIALS

G.A. HEGEMIER, Univ. of California, School of Engineering, *San Diego*, *California* 92038 (DF044960; F49620-76-C-0024)

AF function - advanced aerospace vehicles require improvements in the thermal and environmental resistance materials and structures to meet mission objectives. Opportunity - three-dimensional carbon-carbon materials and advanced composites now being considered by the Air Force require material and structural characterization and environmental response predictions in order to reduce development uncertainties. Objective - the objective of this research is to develop a basic mechanics model of composite materials based on microconstituent properties in order to predict failure and damage under dynamic loadings and exposure to hygrothermal conditions. How work contributes - the major portion of this research is part of the joint AFOSR/ONR program to develop a basic understanding of carbon-carbon.

Research efforts will investigate the extension of existing theories to the following areas - (1) global and local stress and deformation fields in composites subjected to dynamic loading conditions, (2) failure modes and damage accumulation, (3) residual properties of damaged composites, (4) diffusion in composite materials, and (5) the conversion of constitutive relations to finite-element form. Methodology is based upon the mixture theory with microstructure concept. All global properties are determined from the composite geometry and the properties of the microcomponents. Such a theory allows a considerable improvement in modeling, guidance in material selection, and is an efficient and effective computational tool.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0009, PEPTIDE AND POLYNUCLEOTIDE CATALYSIS OF AMINO ACID CONDENSATION ON HYPOHYDROUS CLAY SURFACES

D.H. WHITE, Univ. of Santa Clara, School of Science, *Santa Clara*, *California* 95053 (NCA 2-685806)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

3.0010, APPLICATION OF THE CUBIC STRENGTH CRITERION TO THE FAILURE ANALYSIS OF COMPOSITE STRUCTURES

R.C. TENNYSON, Univ. of Toronto, *Toronto*, *Ontario*, *Canada* (NSG 7409)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

3.0011, FRACTURE AND FATIGUE CHARACTERIZATION OF AIRCRAFT STRUCTURAL MATERIALS UNDER BIAXIAL LOADING

D. JONES, George Washington Univ., Graduate School, *Washington*, *District of Columbia* 20006 (DF045860; AF-AFOSR-3099-76)

AF function - to contribute to a better understanding of fatigue and fracture processes for structural materials so that their life-cycle serviceability might be optimized. In this manner, Air Force flight vehicles can, ultimately, be much improved. Deficiency - a better understanding about flaws and their associated effects under biaxial loading will allow designers to consistently improve flight worthiness. objective - this research program is given to the problem of understanding the effect of biaxial loads on cracked metal specimens. How work contributes - better knowledge about the behavior of structural materials under biaxial stress conditions should serve to improve Air Force flight systems and their components.

The primary emphasis of the analytical research effort will be to formulate the proper foundation for fracture mechanics applications under biaxial applied loads. The experimental portion will emphasize the determination of the effects of biaxial applied loads on the fracture toughness and on fatigue crack growth rates.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0012, FUNDAMENTAL APPROACH TO PROBLEMS IN CERAMIC ENGINEERING

H. LIEBOWITZ, George Washington Univ., School of Engin. & Appl. Sci., *Washington, District of Columbia* 20037 (DF046050; AF-AFOSR-3114-77)

AF function - this proposed research primarily falls in the 2.1 research objectives which deal with failure processes. Basic research to identify new families of ceramic materials capable of economical consolidation to densities approaching 100 percent and possessing improved creep and thermal fatigue resistance is needed for extending limits of future generation expendable and recoverable high-temperature turbine engine components. A rational basis for the development of alloys, nonmetallic materials, ceramics, and composites which are stronger is needed for all Air Force systems. Deficiency - failure processes such as fatigue, fracture, and creep are in most cases intimately related to the microstructure of alloys, polymers, ceramics, and composites. Understanding of these processes and properties mechanisms must be integrated with appropriate constitutive equations and appropriate failure criteria. Considerable progress can be achieved in structural reliability and integrity as a result of some basic studies. Objective - an alternative approach to problems in ceramic engineering is proposed, exploiting the constructs and methodology of solid-state physics. It is proposed to computer-simulate crack tips, dislocation cores, and grain boundaries within a lattice model employing realistic potentials. The lattice model will be based on a variation of the lattice statics method. Contribution - this research is a part of a comprehensive program to use statistical mechanics on real systems.

This proposal suggests two areas of investigation which provide a more accurate and realistic computer simulation of flaws. The first development will utilize a variation of the lattice statics method in order to treat a fully discrete lattice. This will eliminate the effects of artificially truncating the size of the discrete region. The second development will be in the area of interatomic potentials. No matter how extensive the computer simulation, if it employs unrealistic potentials as input data, then the results must carry the same degree of uncertainty. The bulk of the computer simulation work has employed empirical potentials. This work will derive accurate potentials for ceramic materials by using techniques from quantum chemistry. Two modifications of Hartree-Fock will be explored which should yield good approximations to the Hartree-Fock solutions in reasonable computational times.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0013, STRUCTURE-PROPERTY-ENVIRONMENTAL RELATIONS IN GLASS AND GLASS-CERAMICS

L.L. HENCH, State University of Fla. Sys., School of Engineering, *Gainesville, Florida* 32611 (DF047230; AF-AFOSR-3210-77)

AF function - advanced aircraft and tactical missile systems employ glass as a structural and optical component which requires superior mechanical, optical and thermal performance under extreme environmental conditions. Deficiency - the methodology for predicting long-term stability and performance of glass and glass-ceramics has not been established. Objective - the objective of this research is to establish predictive structure-property-environmental relations in glass and glass-ceramics. How work contributes - this research is expected to establish the relationships between environmental exposure and use and the non-destructive testing procedures for predicting long-term stability and performance in glass and glass-ceramics.

Glass chemistry will center on (1) alkali silicate, commercial, and other glasses and glass-ceramics, (2) the development of techniques to obtain quantitative analysis of the residual glassy phase, (3) the effects of the glassy phase on various physical properties and (4) environmental deterioration of the glassy phase and the effect of the deterioration on the physical properties.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0014, HIGH-TEMPERATURE MOLECULES AND MOLECULAR ENERGY STORAGE

W. WELTNER, State University of Fla. Sys., School of Arts & Sciences, *Gainesville, Florida* 32601 (DF042010; AF-AFOSR-2906-76)

AF function - rocket propulsion, electromagnetic weaponry. Deficiency - structural and spectroscopic information on molecular species found in high-temperature systems such as wakes, plumes, nozzles, lasers and combustors is required for improved design features of Air Force systems. Objective - research includes optical and electron spin resonance (ESR) spectroscopy of molecular species and the spin-alignment of radicals at high magnetic fields and low temperatures. How work contributes - the optical and ESR spectra of high-temperature species provides information of vibrational, electronic and magnetic energy levels which is useful in plume identification and suppression and in the development of advanced lasers. Spin aligned radicals provide a potentially important source of advanced, high-energy propellants.

Species are vaporized and trapped in solid argon matrices at 4-10 degrees K for the study of their optical and ESR spectra. Species to be examined include carbon molecules (C5, C6, C3N), silicon species (SiC, SiO2), and the oxides, hydrides, and nitrides of the transition metals Mn, Fe, Cr, Ni and Yb. A molecular energy storage apparatus will be constructed to allow spin alignment of radicals at high magnetic fields and low temperatures.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0015, RELATION OF STRUCTURE TO FATIGUE PROPERTIES IN ALUMINUM-BASE ALLOYS

M.E. FINE, Northwestern University, Technological Institute, *Evanston, Illinois* 60201 (DF041810; AF-AFOSR-2892-76)

AF function - the longevity, reliability and safety of aerospace structures are related to the fatigue properties of the structural materials used. In fact, the fatigue properties of structural materials often limit their application. Opportunity - it is important to understand the mechanism of fatigue and especially the metallurgical means by which fatigue resistance may be improved. Objective - this research will relate fatigue crack initiation, fatigue crack propagation, and the character of the plastic deformation from cyclic loading to the structure of aluminum base alloys, particularly those which contain copper as the major precipitation hardening alloying element. How work contributes - such information will point the way to development of improved fatigue-resistant aluminum base alloys. Since aluminum alloys form a major portion of the material currently used for skin and other structural airframe applications, it is appropriate that they are the basis of this investigation.

The effects of several different kinds of precipitates and other dispersed phases will be investigated. In addition, this research will determine a method of simultaneously increasing both the cyclic yield stress and the effective surface energy for fatigue crack propagation.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0016, HIGH-TOUGHNESS GRAPHITE/EPOXY COMPOSITE MATERIAL EXPERIMENT FOR THE LONG DURATION EXPOSURE FACILITY (LDEF) PHASES I AND II

D.K. FELBECK, Univ. of Michigan, School of Engineering, *Ann Arbor, Michigan* 48106 (NAS 1-15333)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

3.0017, MORPHOLOGY OF KEVLAR FIBERS

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SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

3.0018, DECONVOLUTION OF GAS CHROMATOGRAPHIC DATA

G.H. RAYBORN, Univ. of Southern Mississippi, School of Science & Technology, *Hattiesburg, Mississippi* 39401 (NSG 1515)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

3.0019, THE RELATION BETWEEN THE CHEMICAL AND PHYSICAL STRUCTURE AND THE MECHANICAL RESPONSE OF POLYMERS

R.P. MORGAN, McDonnell Douglas Astro. Co., *St. Louis, Missouri* 63166 (DF043420; F44620-76-C-0075)

AF function - advanced aircraft utilize polymeric matrices for composite materials, adhesives and transparencies which are subjected to extreme service environments. Deficiency - the basic understanding for predicting the lifetime of these polymers in the service environment is lacking. Objective - the objective of this research is to determine how the chemical and physical structure of polymeric glasses is related to the failure modes, mechanical properties, fabrication procedures and environmental factors. How work contributes - it is expected that this research will contribute to the understanding which must be established before laboratory simulation tests can be constructed which will predict in-service failures in polymeric matrices.

Research will center on (a) determination of the chemical and physical structure of epoxies by several current and advanced characterization techniques, (b) monitoring the microvoid characteristics as a function of cyclic heat and moisture exposure, (c) determination of the failure modes of the epoxies, their modification by the presence of low molecular weight material and their relation to the network structure and microvoid characteristics, and (d) study of the effect of strain-rate and test temperature on mechanical properties to elucidate size of the entities involved in the flow processes.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0020, LASER IRRADIATION OF METALS AND ALLOYS

O.T. INAL, New Mexico Inst. Min. & Tech., Graduate School, *Socorro, New Mexico* 87801 (DF041110; F44620-75-C-0076)

Fatigue, fracture, and damage by intense electromagnetic radiation must be evaluated to determine both the effectiveness of laser systems and the vulnerability of materials to laser radiations. In particular this proposal will look into direct observation and analysis of laser thermal and shock effects in metals and alloys. They will use techniques of transmission and scanning electron microscopy as well as field-ion microscopy to investigate the atomic structural features. This study will provide evidence of point defect production in shock loading and laser degradation at the atomic level. Direct observations of laser-induced phase transformations and related phenomena such as the formation and equilibrium properties of Guinier-Preston zones are goals of this proposal.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0021, MEASUREMENT OF IR SIGNATURES OF MOLECULAR SPECIES FROM ADVANCED ROCKET PROPELLANTS

A.L. RUSSO, Calspan Corporation, *Buffalo, New York* 14221 (DF043710; F44620-76-C-0090)

AF function - improved capabilities for early-warning launch phase detection require information on the exhaust plume ir signature from combustion of non-conventional rocket propellant combinations and from the interaction of the exhaust with the ambient environment. Deficiency - there is a lack of quantitative data on vibration-rotation band strengths, vibrational relaxation rates and chemical reaction mechanisms for exhaust species from advanced propellant combinations in the SWIR and LWIR region of the spectrum. Objective - investigate the relative importance of radiating species in the short-wave and long-wave infrared wavelength region and determine vibration-rotation band strengths of the dominant species for non-conventional rocket propellants. How work contributes - provides fundamental spectroscopic data to assist development of computer codes for predicting plume radiation pertinent to detection and surveillance.

Conduct shock tube experiments to identify relative radiative importance in the short-wave and long-wave IR region of various species which result from combination of boron-containing fuels. Measure IR band intensities of dominant species. Monitor the thermodynamic temperature to establish equilibrium conditions and to establish suitability of existing thermochemical data on calculations of band strengths.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0022, HIGH-TEMPERATURE CHEMICAL KINETIC STUDIES

E.L. RESLER, Cornell University, School of Engineering, *Ithaca, New York* 14850 (DF004950; AF-AFOSR-2744-74)

AF function - aerospace vehicles, air-breathing propulsion. Opportunity - both present and future Air Force aerospace vehicles will be required to fly at high speeds and both ecological and military demands are for systems that do not create observable pollution of the atmosphere. This requires that design for sustained high-speed flight, atmospheric entry or radiation devices be reduced to an accurate engineering practice so that wake observables, radar cross section and atmospheric pollution will be reduced to an absolute minimum. This is not now possible especially for those regimes where gas properties are affected by the high-temperature reactions that take place in the flow. The complex physico-chemical processes that take place in the boundary layers on the nose cones of hypersonic vehicles and the mechanism of pyrolysis of simple hydrocarbons and fluorocarbons, for example, have common features at the fundamental level. This research proposes to develop the requisite understanding of these processes so that the knowledge can be applied to reducing the NOx in the exhaust from jet engines as well as control the electron densities in the wakes of hypersonic velocites. Objective - to obtain by aerodynamic means fundamental data on the physical and chemical behavior of selected gases at high temperatures and to determine the fate of molecular species under conditions which simulate the flow around a body and in its wake as well as in the exhaust of jet engines. How work contributes - there is an unavoidable fixation of nitrogen and the production of ions and electrons through the bow shock of hypersonic vehicles. This leads to enhancement of radar cross section as well as augmented wake signature at high altitudes.

The role of vibrational energy of a molecule and the part it plays in atomic displacement reactions will continue to be studied by means of laser stimulation. Measurements in a shock tube of the initial stages of pyrolysis of simple gases and NOx reduction in the presence of traces of an added easily oxidizable substance will be made. The experimental portion of the work is performed in a simple pulse shock tube.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0023, PHOTOCHEMICAL DISSOCIATION FROM SELECTED ROVIBRONIC STATES IN POLYATOMIC MOLECULES 12610-C

G.H. ATKINSON, Syracuse University, School of Arts & Sciences, *Syracuse, New York* 13210 (DA0G5573; DAAG29 75 G0104)

To study the relationship between the molecular properties associated with excited states and the decay mechanisms (including photo-dissociation) exhibited by polyatomic molecules. This research is relevant to in-house research on countermeasures against laser-surveillance (Natick) and to the work at FA on the mechanism of the combustion of high-energy aliphatic nitro compounds as small arms propellants.

Unique excited states of polyatomic molecules (with well-defined energies) will be produced by means of high-resolution tunable lasers. The research will include measurements of (1) quantum yields - (2) the rates of product formation - and (3) the internal energy of a given product.

SUPPORTED BY U.S. Dept. of Defense, Army Materiel Development & Readiness Command, Army Research Office

3.0024, IMPROVED HIGH-MODULUS CARBON FIBERS

G.S. ANSELL, Rensselaer Polytechnic Inst., School of Engineering, *Troy, New York* 12181 (NSG 1510)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

3.0025, NAVY VEHICLE DESIGN AND CONSTRUCTION - DISPERSION-STRENGTHENED METAL ALLOYS

G.S. ANSELL, Rensselaer Polytechnic Inst., School of Engineering, *Troy, New York* 12181 (DN525008; N00014-76-C-0458)

The Navy has a need for high-strength, high-toughness metal alloys for use in a wide variety of components ranging from pumps and compressors to aircraft frame structure and jet engine parts. Improved alloys would result in greater reliability, better performance and/or decreased weight. In this research the investigator will explore mechanisms of strengthening in metal alloys, with emphasis on martensitic steels and nickel alloys for use at high temperatures.

The hardening mechanism and associated mechanical properties will be examined in alloy steels from the following viewpoints: kinetics of the austenite to martensite transformation; effect of austenitic shear strength on the transformation to martensite; strain effects accompanying the volume change that occurs as martensite forms. The effects of alloy composition on the above areas will be noted. Strengthening of nickel alloys by gamma prime precipitation will be examined to determine the role of coherency strains on high-temperature properties.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

3.0026, PATTERNS OF RESIDUAL STRESSES WITHIN COMPLEX WELDED STEEL STRUCTURES

B.M. BOTROS, Univ. of North Carolina, School of Engineering, *Greensboro, North Carolina* 27411 (NSG 1516)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

3.0027, EFFECTS OF MOISTURE AND TEMPERATURE ON POLYMER-MATRIX COMPOSITES 15183-MS

J.C. HURT, Univ. of North Carolina, School of Engineering, *Raleigh, North Carolina* 27607 (DA0F8987; DAAG29 77 G0124)

To study the mechanisms of degradation of polymer-based fiber-reinforced composites in the presence of moisture and moderately high temperatures. Relevance - this research is relevant to the performance of polymer matrix composites for applications such as helicopter components (e.g. rotor blades and fuselage panels), personnel armor, tank wheels, missile motor cases, rocket launch tubes, and electronic circuit boards. The environmental degradation of polymer matrix composites has been referred to as the Army's number one problem in the area of composites.

The study will include: (1) experimental determination of the temperature- and moisture-dependent mechanical properties of the constituent polymers and fibers, as well as the composites; (2) determination of the absorption and diffusion coefficients for moisture in the constituent resin and fibers; (3) determination of the mechanisms of interaction of the moisture with the composite; and (4) development of a micromechanical model to describe the elastic and elastic-plastic behavior of the composite.

SUPPORTED BY U.S. Dept. of Defense, Army Materiel Development & Readiness Command, Army Research Office

3.0028, MICROSTRUCTURAL EFFECTS AND FATIGUE LIFE PREDICTIONS OF NICKEL BASE SUPERALLOYS

S.D. ANTOLOVICH, Univ. of Cincinnati, School of Engineering, *Cincinnati, Ohio* 45221 (DF042780; AF-AFOSR-2952-76)

AF function - nickel base superalloys are used in critical jet engine components that experience repeated loads (fatigue) and long hold times at elevated temperatures. Opportunity - these materials can undergo significant microstructural changes when subjected to the combination of high temperatures and moderate stresses which may profoundly affect the fatigue life. However, these changes are not currently incorporated in conventional fatigue life prediction procedures. Objective - this research will determine the effects of microstructural variations in influencing the fatigue life of cast, nickel-base superalloys used for jet engine turbine blades. How work contributes - the results of these tests will be used to develop models of the fatigue process which incorporated microstructural and strain rate effects, and to define the way in which life predictions of notched components can be made using tensile and smooth bar test results.

Experiments will be carried out on ReNe-80 material in both air and inert environments to unambiguously assess the importance of these changes on fatigue performance. Tensile, notched and smooth bar specimens will be tested as a function of strain rate and microstructure over the temperature range of 1400 to 1800 degrees F.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0029, PROTON ACTIVATION STUDIES OF DIFFUSION AND OXIDATION IN SILICON NITRIDE

A.R. COOPER, Case Western Reserve Univ., School of Engineering, *Cleveland, Ohio* 44106 (DF680830; F33615-74-C-4029)

AF function - high-temperature propulsion materials, thermal protection materials and power generator materials. Deficiency - failure of materials to perform at high temperatures in oxidizing environments due to degradation of their requisite physical, chemical or mechanical properties. Research - proton activation analysis studies will be made to determine the mode and rate at which the various anions are transported in silicon nitride and in the oxide scales formed on it during oxidation. The studies will include determination of nitrogen transport rates in both the silicon nitride and its silica scale and oxygen transport rates in the silica scale. How research contributes -an understanding of the fundamental transport mechanisms active in ceramics to be used for various high-temperature applications is essential if significant long-range improvements are to be made. The data generated by this study will complement the in-house research on work unit 7021-03-37 where the reaction kinetics and detailed microstructure analysis resulting from the same high-temperature oxidation process have been determined. The resulting mechanistic understanding of the degradation process can lead to modification in material composition, surface condition, etc., in a scientific manner to improve the high-temperature behavior of silicon nitride.

Proton activation will be used as a means of detecting super 18 O through the use of super 18 O (p, alpha) super 15 N reaction and detection of the energetic alpha particles produced. This method, when combined with serial sectioning, provides a straightforward means of determining a super 18 O concentration

profile; the number and energy distribution of alpha particles produced for a given proton flux is used as a measure of the super 18 O concentration within each successive section.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Materials Lab.

3.0030, CROSS IMPACT ASSESSMENT OF FIBRE OPTIC TECHNOLOGY DEVELOPMENT
J.P. MARTINO, Univ. of Dayton, Res. Inst., *Dayton, Ohio* 45409 (NAS 3-21355)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

3.0031, THE EFFECT OF PHOSPHORUS ON THE DEVELOPMENT OF THE STRUCTURE OF IRON METEORITES
J.I. GOLDSTEIN, Lehigh University, School of Engin. & Phys. Sci., *Bethlehem, Pennsylvania* 18015 (EAR74-22518 A01)

This project is a determination of the cooling rates of iron meteorites. Recent study of the system Fe-Ni-P has shown that phosphorus has a strong influence on the diffusion rates of iron and nickel in various mineral alloys and promotes the nucleation of Widmanstatten structures. Previous estimates of the cooling rates of iron meteorites have been based on experimental results in the phosphorus-free system and are thus significantly in error. The present study will be the simulation of growth of Fe-Ni (-P) minerals and the Widmanstatten pattern by computer methods. The computer simulation method is based on experimentally determined ternary diffusion coefficients and phase relationships. The computer program has been tested on a preliminary manner and found viable predicting experimental results. The cooling rates thus obtained will be used to interpret the mode(s) of formation of various types of iron meteorites and their parent asteroidal bodies.

SUPPORTED BY U.S. National Science Foundation, Div. of Earth Sciences

3.0032, APPLICATION OF FINE MESH PARTICLES TO METAL AND ORGANIC SUBSTRATES FOR ION BEAM TEXTURING APPLICATIONS
F.J. MICALE, Lehigh University, School of Arts & Sciences, *Bethlehem, Pennsylvania* 18015 (NSG 3193)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

3.0033, PHASE TRANSFORMATIONS AND NON-EQUILIBRIUM INTERFACES IN ALLOYS
J.S. LANGER, Carnegie Mellon University, Mellon Institute of Science, *Pittsburgh, Pennsylvania* 15213 (DF043970; F44620-76-C-0103)

AF function - this proposed research primarily falls in the 2.1 research objectives which deal with new materials research. The goals are to form a rational basis for creating or improving material systems such as alloys, polymers, ceramics, and composites. This can be attained through understanding of the principles that govern the properties and gross behavior as functions of microstructural features. Deficiency -the understanding of phase transformations is of vital importance to the development of desirable material properties by the metallurgists. This is especially true for aircraft applications where high performances-to-weight ratios are vital, as, for example, in the lightweight titanium-based alloys. Objective - the objective of this proposal is to perform investigations of non-equilibrium interfaces. In particular study the instabilities, cellular structures, and the onset of dendritic growth, study the departures from local equilibrium and the theory of interface control. Apply the theory of spinodal decomposition developed by one of the investigators to realistic systems and to make models of isothermal solidification in the liquid-layer joining process. Contribution - this research is a part of a new comprehensive program in statistical mechanics.

This proposal is to investigate the general area of non-equilibrium interfaces. In contrast to a detailed study of interfacial kinetics, this project looks at the interfacial stability and the formation of cellular or dendritic structures during phase transformations. These basic concepts are relevant to a broad range of solid-liquid and solid-solid phase transformations. The anaylsis is an extension of the results of Mullins and Sekerka who studied the stability of smooth interfaces and were able to determine critical values of various parameters at which such an interface would become unstable with respect to changes of shape on a scale of typically several microns. Their analysis was completely linear and incapable of predicting what happens after the instability occurs. In this proposal the investigators borrow recent developments in the theory of hydrodynamic instabilities and the onset of turbulence. In the part on the theory of spinodal decomposition, the basic theoretical phase of this is now complete from previous investigations and the mathematical tools which have been developed are ready for detailed applications.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0034, DEVELOPMENT AND VERIFICATION OF STRESS LEVEL STANDARDS
J.J. WERT, Vanderbilt University, School of Engineering, *Nashville, Tennessee* 37203 (NAS 8-32894)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

3.0035, DEVELOPMENT OF PRACTICAL MO TECHNIQUES FOR PREDICTION OF THE PROPERTIES AND BEHAVIOUR OF MATERIALS
M.J. DEWAR, Univ. of Texas, School of Natural Sciences, *Austin, Texas* 78712 (DF039910; AF-AFOSR-2749-75)

AF function - Air Force flight operations have continuing needs for improved structural, environmental resistant and elastomeric materials. Deficiency - a need exists for methods of predicting the best approaches to making new materials. Objective - the purpose of this research is to develop practical procedures for applying fundamental physical theory to the prediction of properties and behavior of organic materials, simple enough, and accurate enough, to be of practical value in the search for new or improved materials of all kinds. How work contributes - the work will provide a basis for the synthesis of desirable new materials without a need for trial and error experimental procedures.

Semi-empirical molecular techniques developed by the principal investigator will be applied to a variety of structural and mechanistic problems where experimental data are lacking or difficult to interpret, particularly photochemical reactions and organometallic compounds. The research will involve mainly the MNDDO/2 approach to calculations.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0036, THE EFFECT OF AN IMPRESSED ELECTRIC FIELD ON THE METAL WORKING OF AIRCRAFT STRUCTURAL MATERIALS
L.R. CORNWELL, Texas A & M University System, School of Engineering, *College Station, Texas* 77843 (DF047030; AF-AFOSR-3193-77)

AF function - Russian scientists have recently reported that plastic deformation of aerospace metals is strongly influenced by impressed electric fields and currents. This research offers a fundamental study of this phenomenological event so that aerospace vehicles, propulsion systems and structural materials might thereby be improved. Opportunity - a scientific explanation of the Russian breakthroughs in this area does not now exist. The opportunity and needs for this research is critical for the national engineering community and results are urgently required. Objective - the objective of this work is to properly characterize the effect of an impressed voltage on an aeronautical aluminum alloy. The phenomenalistic events are to be interpreted for extension to real

systems involving deformation mechanics. How work contributes - part of the AFOSR mission is to provide a scientific understanding for complex engineering or technological problems. This research will serve the interests of the USAF by giving solutions to foreign technology problems which are not yet understood.

As a first step to assessing the application of this so-called electroplastic effect to practical problems, the simple expedient of rolling an aluminum alloy while an electric current is being applied is suggested. The rolling load will be monitored and the percent ductility determined and compared to the corresponding values in the absence of an electric current. The resulting mechanical properties and microstructure will also be determined to assess the effect on these parameters. Analytically, the program will interpret the data and results in terms of mechanical metallurgy so that improved metalworking methods for solid mechanics might thereby be improved.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0037, ADVANCED MATRIX RESINS FOR GRAPHITE COMPOSITES
J.E. MCGRATH, Virginia Poly. Inst. & St. U., School of Arts & Sciences, *Blacksburg, Virginia* 24061 (NSG 1512)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

3.0038, NEW AROMATIC POLYAMIDES CONTAINING N-PROPARGYL GROUPS AS POTENTIAL CROSS-LINKING FUNCTIONS
J.F. WOLFE, Virginia Poly. Inst. & St. U., School of Arts & Sciences, *Blacksburg, Virginia* 24061 (NSG 1524)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

3.0039, DEVELOPMENT OF HIGH STRENGTH AND TOUGHNESS 7000 SERIES ALUMINUM ALLOYS
S.G. CUPSCHALK, Old Dominion University, School of Engineering, *Norfolk, Virginia* 23508 (NSG 1521)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

ENGINEERING

Includes Engineering (general); Communications; Electronics and Electrical Engineering; Fluid Mechanics and Heat Transfer; Instrumentation and Photography; Lasers and Masers; Mechanical Engineering; Quality Assurance and Reliability; and Structural Mechanics. For Related Information See Also Physics.

4.0001, FLUIDIC TECHNOLOGY INVESTIGATIONS - RATE SYSTEM FOR 2.75 INCH ROCKET
J.C. DUNAWAY, U.S. Army, Guidance & Control Directorate, *Huntsville, Alabama* 35809 (DA0F1300)

The object of this program is to develop a low-cost fluidic rate control system to limit the dispersions of the 2.75 rocket system when fired from the harsh environment of a hovering helicopter.

A fluidic laminar rate sensor and a level detector circuit will be designed and breadboarded. A thrust vector control scheme will be developed and integrated with the rate sensor circuit. Static test will be conducted to demonstrate the systems operation.

SUPPORTED BY U.S. Dept. of Defense, Army Materiel Development & Readiness Command, Harry Diamond Lab.

4.0002, FLUIDIC TECHNOLOGY - ACTUATION SYSTEMS
W.A. GRIFFITH, U.S. Army, Radar Technology Laboratory, *Huntsville, Alabama* 35809 (DA0F1072)

The objective of this task is to develop fluidic technology for missile control system applications. Emphasis is placed on control actuators utilizing fluidics for use on thrust vector control and on aerodynamic control surfaces.

The program will be an in-house program to develop a fluidic input actuator for use in a thrust vector control scheme which inserts a cylindrical obstacle in the exit cone of a rocket nozzle to vector the thrust. The cylindrical obstacle will be part of the actuator piston and will eliminate the use of linkages which will lower the cost and increase the reliability. Also, an existing closed center pneumatic actuator will be modified to accept fluidic inputs rather than electrical inputs. Evaluation of the actuator will be made after modification.

SUPPORTED BY U.S. Dept. of Defense, Army Materiel Development & Readiness Command, Harry Diamond Lab.

4.0003, DYNAMIC RESPONSE OF SOLID ROCKET MOTORS TO TRANSVERSE BLAST LOADS
T.L. COST, Athena Engineering Company, *Northport, Alabama* 35476 (DA0N4518; DAAD05-76-C-0751)

The objective of this effort is to develop the theory and computer program required to predict the structural response of a solid rocket motor subjected to transverse air blast loads while simultaneously subjected to internal pressure and transverse acceleration loads.

The approach to the problem will be primarily theoretical and will involve the development of a structural analysis method which can be implemented on a digital computer.

SUPPORTED BY U.S. Dept. of Defense, Armament Research & Development Command, Ballistic Research Labs.

4.0004, LOW-SPEED SEPARATED FLOW STUDIES FOR NAVAL AIRCRAFT
P. DODGE, Signal Companies Incorporated, *Phoenix, Arizona* 85034 (DN475377; N00014-74-C-0317)

The effectiveness of aircraft, whether conventional or V/STOL, at low speeds is reduced by flow separation. The separation is caused by adverse pressure gradients induced by deflected control surfaces or high incidence angles of the wings. This research is a numerical approach, within the framework of the Navier-Stokes equations, to the development of a methodology for the calculation of low-speed separated flows for improved aircraft performance.

Flow separation on wings or control surfaces at low speeds is an extremely complex phenomenon which can, at this time, be described, in general, only by detailed experiments or possibly by numerical calculations for an extremely limited set of special cases. It is beyond the scope of conventional boundary layer theory, and hence predictive procedures must rely on phenomenological modeling or higher order approximations. In the proposed investigation, the full Navier-Stokes equations will be solved numerically by a technique which involves splitting the momentum equation into two parts, not unlike boundary layer theory. One part contains the inviscid-like pressure terms and can be solved by elliptic methods. The second part, which is of course coupled to the first equation, contains the viscous terms directly; is parabolic in nature, and can be solved by marching techniques. Iteration will be carried out for the coupling.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

4.0005, OPTICAL PROCESSING STUDY
F. HARRIGAN, Science Applications Inc., *La Jolla, California* 92037 (DF902330; F19628-77-C-0110)

AF function - surveillance, communications. Deficiency - wideband radar optical and communciations signals can not be processed to provide desirable system performance. How research contributes - optical signal processing can potentially provide enormous gains in signal processing capability if suitable devices performing the processing can be developed.

The advantages and disadvantages of optical signal processing techniques, alone or in combination with other techniques, will be explored. Technology developements necessary to carry out optical processing schemes where they offer advantages will be pointed out and promising approaches will be analyzed. Emphasis will be on real time processing in applications to wideband radar, spread spectrum communications, electrooptical surveillance and signal intelligence. Both coherent and incoherent techniques will be explored.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Rome Air Development Center

4.0006, THREE-DIMENSIONAL UNSTEADY FLOW THEORY

S.S. STAHARA, Nielsen Engin. & Research Inc., *Mountain View, California* 94040 (DN323079; N00014-73-C-0379)

The prediction of aircraft performance during rapid maneuvering, while encountering gusty environments, or to avoid flutter requires a knowledge of unsteady aerodynamic forces. The purpose of this task is to develop an accurate 'analytical' method for calculating the unsteady pressures, forces and moments on broad classes of three-dimensional configurations (wings, slender bodies and wing-body combinations) at transonic speeds.

Though rapid advances have been made in the numerical solution of complex flow fields, the calculation of unsteady aerodynamic flows about three-dimensional configurations by finite-difference techniques remains a distant goal because of the computing time involved. In the research under investigation, an analysis of oscillatory motion at transonic speeds will be undertaken. In this analysis it will be assumed that the oscillatory flow is a small perturbation on a basic nonlinear steady flow, which can be obtained theoretically or experimentally. The resultant equation for the oscillatory flow will be solved by the method of local linearization to predict the characteristics of three-dimensional configurations.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

4.0007, SURFACE RADIATION EFFECTS IN HGCDTE

F.A. JUNGA, Lockheed Missiles & Space Co., *Palo Alto, California* 94304 (DF900820; F19628-75-C-0127)

AF function - surveillance, detection and weapons delivery. Deficiency - operational capability of IR detector systems can be seriously affected upon exposure to nuclear radiation. Objective - determine the long-term effects of ionizing radiation on the surface properties of HgCdTe IR detectors. How research contributes - since both detector sensitivity and noise are affected by surface properties, this data is needed to assess the performance of hgcdte ir detectors exposed to nuclear radiation. Data is also provided to develop techniques to harden these detectors to radiation.

MWIR (3 to 5 microns) and LWIR (8-14 micron) HgCdTe photoconductive detectors with special metal field plates will be irradiated with cobalt-60 gamma source at 77 degrees Kelvin. Before and during irradiation as well as after post-irradiation anneals surface properties will be measured using capacitance-voltage and conductance voltage techniques. At the same time detector performance parameters including responsivity and detectivity will be measured.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Rome Air Development Center

4.0008, IMPROVED FLOW VISUALIZATION BY USE OF RESONANT REFRACTIVITY

D. BERSHADER, Stanford University, School of Engineering, *Palo Alto, California* 94305 (DF038630; AF-AFOSR-2670-74)

AF function - aerospace vehicles. Opportunity - Air Force flight operations depend on the science of aerodynamics for the quantitative prediction of performance and loads on vehicle surfaces, both for operational use and especially for rational design. Optical methods, viz shadowgraph, Schlieren and interferometry, are important and long-established tools of experimental aerodynamics. However, there is a need for obtaining highly increased sensitivity in these refractive optical methods so that subtle fluid dynamical phenomena, such as weak vortices, sound waves, and low-density flow fields can be made visible (qualitatively and quantitatively) to the experimental fluid dynamicist. With the advent of the laser, resonant refractivity should provide this needed highly increased sensitivity in refractive optical systems. Objective - to develop a resonant refractive system for air and to demonstrate its use with a simple flow field. How work contributes - it has long been known that where flow phenomena include variations in optical refractivity unique possibilities are created for flow visualization. The relation commonly employed by experimental fluid dynamicists, the so-called Dale-Gladstone formula, shows a linear relation between the refractive index and the density. This research examines the nature of the proportionality parameter in the Dale-Gladstone relation with the objective of determining ways of increasing the proportionality factor, since any increase in this factor implies a corresponding increase in the gradient sensitivity of a Schlieren system or in the fringe shift when doing interferometry, thus making optical systems for experimental use capable of delineating subtle flow phenomenon now beyond our capability. Any advance of this type in research tools, either analytical or experimental, should make for significant progress in subsequent basic and/or applied research activities.

The refractive effect of introducing sodium vapor as a tracer is being investigated. Detailed line shapes for sodium mixed with various background gases are being measured and predicted theoretically. The background gas must be taken into account because of its influence on the line broadening. The line shape must be known in order to interpret flow field optical measurements by relating index of refraction to gas (i.e., sodium vapor) density. (Text abridged.)

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0009, X-RADIATION FROM ELECTRON SOLID INTERACTION

A. YARIV, Calif. Inst. of Technology, Graduate School, *Pasadena, California* 91109 (DF042500; AF-AFOSR-2933-76)

AF function - non-destructive testing of structural members of aerospace vehicles could benefit greatly from the development of an X-ray laser for use in three-dimensional holography. Opportunity -attempts to develop an X-ray laser by standard population inversion techniques have been unsuccessful primarily because of short life times of excited states. Objective - the objective is to provide a theoretical basis for the non-divergent X-ray beams discovered by Das Gupta. How work contributes - this research will add to the body of knowledge on high-energy electron-solid matter interaction which could lead to the development of X-ray lasers.

Previous research on electrons-electromagnetic traveling wave interactions will be extended to investigate interaction mechanisms between vacuum accelerated electrons and (1) X-rays from surfaces of crystalline and non-crystalline solid matter, and (2) X-rays from the interior of single crystals.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0010, FINE-SCALE STRUCTURE OF TURBULENT VELOCITY FIELDS

F.H. CHAMPAGNE, Univ. of California, School of Engineering, *San Diego, California* 92038 (DF046560; AF-AFOSR-3172-77)

AF function - advanced aerospace vehicles. Deficiency - lack of understanding about turbulence and turbulent flows. Objective -investigate the phenomenon of relaminarization of turbulent pipe flow and the structure of the atmospheric surface layer. How work contributes - better knowledge of the basic mechanism of the relaminarization process will provide a better understanding of turbulence and transition to turbulence. This will be directly applicable to the design of future aerospace vehicles.

An experimental program for the relaminarization of turbulent pipe flow will be established with the following goals: 1) establish the minimum downstream Reynolds number for which the flow remains turbulent through the diffuser and downstream, 2) measure the development of the mean velocity field, 3) mea-

sure the decay rate of the turbulent velocity components' shear stress and their respective spectra and co-spectra at various locations, and 4) examine the turbulent energy at various phases of the reverse transition process. The possible relationship between the organized structure of surface atmospheric data and laboratory shear flows will be investigated.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0011, MIXING AND COMBUSTION MECHANISMS IN HIGH-SPEED AIR FLOWS
R.B. EDELMAN, Science Applications Inc., *Woodland Hills, California* 91364 (DF047420; F49620-77-C-0044)

AF function - advanced air-breathing engines, airborne weapons delivery. Deficiency - insufficient understanding of basic mechanisms and processes involved in advanced high-speed combustors and lack of realistic guidelines for predicting propulsion system performance. Objective - to formulate realistic mathematical representation of mechanisms and processes associated with turbulent reacting flow fields encountered in advanced air-breathing combustors, and augmentors, e.g., dump, premixing/prevaporizing, annular burners, common-and-mixed-flow afterburners. How work contributes - will provide additional understanding and realistic analytical modeling of reactive flow fields not now available and contribute to advance air-breathing engine technology base. Present advanced propulsion system design and development depend heavily on expensive cut-and-try methods.

Theories describing chemical kinetics and mixing phenomena in subsonic and supersonic fuel-air flows will be formulated and evaluated. Included will be investigation of transport phenomena in nonreacting and reacting flows. Mechanisms will be studied for accelerating and enhancing mixing and combustion processes to minimize length for combustion completion, including coupled chemical and mass transport processes with pressure distribution and geometric effects. Effects of sudden expansion and effects of interphase transport including particulate phase evaporation on injection and mixing, ignition, flame stabilization and propagation, and on combustion instabilities and efficiency will be studied. Also studied will be coupling of mechanisms describing ignition, combustion and mixing processes associated with direct injection of multiphase fuels into high-speed air streams. Various fuels will be investigated including hydrogen, hydrocarbons, including those derived from non-petroleum sources, slurries and metal particles.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0012, ENVIRONMENTAL EVALUATION OF INSULATIVE THERMAL PROTECTION SYSTEMS (TPS)
R.L. KIRLIN, Martin Marietta Corporation, *Denver, Colorado* 80201 (DF133060; F33615-77-C-3078)

Bond-on, insulative thermal protection systems offer a low-cost option for application to hypersonic cruise research vehicles, missiles and some forms of entry vehicles. It is necessary to empirically evaluate the effects of such TPS materials when design features such as holes and protuberances through and from the vehicle outer surface are present. To cyclically test, evaluate and develop design criteria for insulative TPS materials, special design problems will be developed, tested and evaluated using the Von Karman facility tunnel C and also the Ames 9 by 2 turbulent duct at simulated M6 flight conditions. The development of a low-cost, easily installed thermal protection system for single or multiple use in hypersonic applications provides a viable option to allow the development of hypersonic research experiments and systems in the 1980's and early 1990's.

Fabricate specimens up to 17 inches by 22 inches of SLA-220 elastomer and RSI tiles bonded to an aluminum substrate. The specimens contain repairs, holes of varying diameter and protuberances of varying shapes. Test in the VKF tunnel C at M6, shear of 3.5 psf and surface temperature of 1300 F and at Ames at M2.5 local, shear of 2.0 psf and surface temperature of 1400 F. Reduce and analyze data, compare with theory and establish design criteria which may be used in system design.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

4.0013, REFINEMENT AND MODIFICATION OF THE CRUTZEN TWO-DIMENSIONAL PHOTOCHEMICAL MODEL
UNKNOWN, Colorado State University, Graduate School, *Fort Collins, Colorado* 80523 (FA77WA-4039; FA160441 (TRAIS NO.))

The contractor shall furnish all of the qualified personnel, facilities equipment, services and material required to perform the effort set forth below: (Task 1) Model Refinement; (Task 2) Tracer Data; (Task 3) Water Vapor Budget; and (Task 4) Effects on Ozone.

SUPPORTED BY U.S. Dept. of Transportation, Federal Aviation Admin.

4.0014, INLET FLOW DISTORTION IN TURBOMACHINERY
B.S. SEIDEL, Univ. of Delaware, School of Engineering, *Newark, Delaware* 19711 (NSG 3189)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

4.0015, EXTENSION OF INSTRUMENT TELEMETRY PACKET FLOW CONTROL SEQUENCING AND ERROR CONTROL TECHNIQUE STUDY
F.O. HADLOCK, State University of Fla. Sys., School of Science, *Boca Raton, Florida* 33432 (NAS 5-24437)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

4.0016, STUDY OF PROCESSING ANALYSIS OF LDAR AND DATA FOR ACCESSING LAUNCH/LANDING HAZARD DUE TO THUNDERSTORMS
D.G. CHILDERS, State University of Fla. Sys., School of Engineering, *Gainesville, Florida* 32611 (NAS10-9378)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

4.0017, GHZ RADIOMETER FOR CONVAIR FLIGHTS
UNKNOWN, Georgia Inst. of Technology, Graduate School, *Atlanta, Georgia* 30332 (NAS 5-24480)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

4.0018, COMMUNICATIONS - STATISTICAL MECHANICS OF NON-EQUILIBRIUM PROCESSES IN PLASMAS AND GASES
M.B. LEWIS, Northwestern University, Technological Institute, *Evanston, Illinois* 60201 (DN524249; N00014-76-C-0089)

This is of interest to the Navy in communication systems via the ionosphere, in ballistic missile and atomic weapons' effects, and in gaseous electronic devices. Specifically, the work consists of studies on non-equilibrium processes in plasmas and gases via statistical mechanics. Since non-equilibrium processes such as turbulence play an important role in these applications, it is important to understand this phenomenon in more detail.

Studies of turbulence and other non-equilibrium processes in plasma and gases are approached from the standpoint of statistical mechanics. The details of plasma turbulence are different from neutral gas turbulence. However, when viewed from the standpoint of statistical mechanics they are conceptually the same, and developments in one area can offer insight into the other. This includes extending the solution of the generalized Boltzmann equation to the case of fully developed turbulent flow

to investigate ideas as a universal turbulent structure and to compare other closure procedures.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

4.0019, AN IMPROVED NONLINEAR DYNAMIC ANALYSIS OF FLAT PLATE LAYERED BODIES ACCOUNTING FOR LARGE TRANSVERSE DEFORMATION
A.R. ZAK, Univ. of Illinois, School of Engineering, *Urbana, Illinois* 61801 (DA0Q4503; DAAD05-77-C-0722)

First objective is to improve on existing finite-element program (TIP) so as to obtain a more realistic determination of stress and deformation. The second objective is to reduce the execution time of the program.

The approach is to improve the constitutive equations used in the present TIP program and, if possible, modify the formulation of the problem so as to reduce the execution time.

SUPPORTED BY U.S. Dept. of Defense, Armament Research & Development Command, Ballistic Research Labs.

4.0020, ON THE RELATIONSHIP BETWEEN TRANSITIONAL AND FULLY TURBULENT SHEAR FLOWS
I.J. WYGNANSKI, Tel Aviv University, *Ramat Aviv, Tel Aviv, Israel* (DF048140; AF-AFOSR-3275-77)

AF function - advanced aerospace vehicles. Opportunity - provide a better understanding of the coherent structures in the turbulent boundary layer. Objective - determine the flow structure within the coherent eddies present in a turbulent boundary layer and mode of interaction among these eddies. How work contributes - will provide data and insight into the coherent structure of turbulent boundary layers which can be used by theoreticians to test their analytical and numerical methods for computing turbulence viscosity models.

An experimental program will be established in the boundary layer of a flat plate to investigate the following - (1) The quantitative mapping of the coherent eddy structure within the turbulent boundary layer using two-point and three-point correlation measurements by realignment of spatial correlations within plus or minus five percent of the free stream convection velocity. (2) The interactions between transitional spots within the laminar layer will be observed to understand how a transitional spot which spreads continuously within the laminar layer is reduced to the dimensions observed in the fully turbulent layer.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0021, JOINT USE OF SPECIALIZED RESOURCES TO SUPPORT QUANTIFICATION AND MATHEMATICAL MODELING OF CLOSED ECOSYSTEMS
K. HIMMELSTEIN, Univ. of Kansas, Graduate School, *Lawrence, Kansas* 66044 (NCA 2-365801)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

4.0022, BASE ANTENNA FLIGHT INSTRUMENTATION (BAFI)
R. PARADIS, U.S. Army, Harry Diamond Laboratories, *Hyattsville, Maryland* 20783 (DA0F5636)

Provide the techniques and equipment needed to perform the flight characterization of a specific design of a vehicle base antenna by measuring the effects of plasma on antenna impedance and two-way propagation loss. The base antenna will have applicability to all future reentry vehicle developments and is compatible with a radar fuze currently being developed for ABRES.

The BAFI experiment will be a payload for the technology development vehicle (TDV) to be launched in November 1977. The BAFI equipment consists of a missile-qualified pulse radar which will measure the two-way signal path loss along the missile trajectory to the earth's surface, a set of three four-probe reflectometers will measure the antenna elements complex impedance during the missile flight. The data will be transmitted to a ground station via a telemetry link. The measured loop loss radar data will be compared to the theoretical plasma free signal loss to yield the plasma-induced signal attenuation vs. altitude.

SUPPORTED BY U.S. Dept. of Defense, Army

4.0023, DESIGN OF AEROSPACE EXPERIMENTAL INSTRUMENTS
J.S. ROCHEFORT, Northeastern University, School of Engineering, *Boston, Massachusetts* 02115 (DF242400; F19628-76-C-0256)

AF function - nuclear weapons delivery, communications, detection, track and intercept. Deficiency - inability to forecast atmospheric interactions affecting the design and operation of military systems such as reentry vehicle, over-the-horizon radar, polar communications and satellite ephemerides. Research - to increase ability to forecast atmospheric variables requires measurements by sounding rocket and satellite experiments. How research contributes - provides instruments for conducting experiments measuring the composition and densities of ion and neutral species of importance to AF systems operations. Research, development and test of components and assemblies are undertaken to create reliable operating instruments for rocket and satellite experiments.

The contractor will design and prepare electronic instruments for mass spectrometer and related experiments as required for a series of rocket and satellite-borne ion and neutral atmospheric composition measurement programs. The design of each experiment will be coordinated with parallel laboratory and other related programs while being updated according to the results of the preceding experiments.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

4.0024, THEORETICAL AND EXPERIMENTAL STUDY OF THE SHEAR LAYER BETWEEN TWO SWIRLING STREAMS
J.L. KERREBROCK, Mass. Inst. of Technology, School of Engineering, *Cambridge, Massachusetts* 02139 (NSG 3187)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

4.0025, ENERGY CONVERSION - STUDIES OF TRANSONIC TURBINES WITH FILM-COOLED BLADES
J.F. LOUIS, Mass. Inst. of Technology, Division of Sponsored Res., *Cambridge, Massachusetts* 02139 (DN475064; N00014-76-C-0253)

The objective of this project is to gather the necessary data essential in developing design procedures for high-performance, cooled, highly loaded transonic turbine stages. The effort is theoretical and experimental in nature and is aimed at reducing the amount of cooling required per unit of work extracted. The research will contribute to increased performance of gas turbine engines needed particularly for naval aircraft propulsion, but useful as well to marine power plants and fixed installations.

Study will be made of heat transfer and shock-film interaction in the blade passages, in optimizing performance and design of blade passages and secondary flow injection. A linear cascade is utilized to test performance of an optimum film cooled blade row. In the final year, effort will involve the effect of injection at various angles, influence of angle of attack and the effect of unsteadiness on aerodynamic and heat transfer performance of the blading.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

4.0026, 118 GHZ RADIOMETER
D.H. STAELIN, Mass. Inst. of Technology, School of Engineering, *Cambridge, Massachusetts* 02139 (DF245370; F19628-75-C-0122)

AF function - weather analysis and forecasting for military operations. Deficiency - inability to determine meteorological conditions over inaccessible or unfriendly territory. Objective - to develop new and advanced equipment and techniques to better utilize the microwave vertical probing capability of the defense meteorological satellite system (DMSS). How development contributes - improves the ability to infer and forecast atmospheric temperature profiles and determines both qualitative and quantitative limits of probing cloud structure. This will allow determination of whether or not 100-200 ghz equipment should be flown on DMSS in the 1980 time frame, and the necessary and optimum processing of satellite data.

A receiver will be constructed utilizing a solid-state mixer diode for switching and a frequency-locked klystron serving as a local-oscillator.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

4.0027, SIMPLIFIED INERTIAL GUIDANCE DEMONSTRATION (SIGD)

J.P. LAUGHLIN, Vought Corporation, *Utica*, *Michigan* 48077 (DA0F1235; DAAK40 76 C 0669)

The technical objective is to design, manufacture, test and deliver three flight demonstration missile airframes with pneumatic controls to be utilized as flight demonstration vehicles to test low-cost strapdown guidance techniques.

The airframe will use solid-propellant motors manufactured during the Greener Pastures program, empty lance E-11 warheads for the nose section, and modified midsection for guidance system mounting. Aft mounted pneumatic controls using four elevons for control will be developed. Midship wings and aft tail/elevon surfaces are being designed based on wind tunnel tests. The government will integrate a ring laser gyro strapdown inertial guidance system into the airframe for feasibility demonstration flight testing.

SUPPORTED BY U.S. Dept. of Defense, Missile Research & Development Command, Guidance & Control Directorate

4.0028, FULL-SCALE FLOW VISUALIZATION FOR AGRICULTURAL AIRCRAFT

E.J. CROSS, Mississippi St. University, School of Engineering, *Mississippi State*, *Mississippi* 39762 (NSG 1511)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

4.0029, AUTOMATION OF I C PROCESS CONTROL EQUIPMENT

G. SMITH, Electronic Associates Inc., *Long Branch*, *New Jersey* 07740 (DF735940; F30602-75-C-0249)

The objective of this program is to automate acquisition and reduction of data from advanced analytical instruments used to study integrated circuit processing. An improvement in the reliability of integrated circuit processing will increase the yield and reliability of integrated circuits used in Air Force electronics.

The approach will be to acquire necessary data acquisition and processing equipment and then automate a capacitance-voltage measurement system, an Auger spectrometer, and a spreading resistance probe. Advantages of such a technique include decreases in man-power expenditures, increased accuracy, and 'real-time' detailed analysis.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Rome Air Development Center

4.0030, STUDIES OF INTERACTIONS OF ELECTROMAGNETIC FIELDS AND PLASMA BEAMS

B.R. CHEO, Polytechnic Inst. of New York, Graduate School, *Brooklyn*, *New York* 11201 (DF038340; AF-AFOSR-2668-74)

AF function - operation of high-altitude vehicles in a post-nuclear explosion environment, development of electromagnetic weapons, space and ionospheric communications as well as countermeasures demand the fundamental understanding of interactions of electromagnetic fields and plasma beams. Deficiency - the aforementioned information required for the design of advanced equipment is not available today. Its acquisition may be realized by a well-planned theoretical and experimental research program. Objective - this program will study the mechanisms of a self-sustaining plasma beam as a guiding structure for high-power electromagnetic fields at microwave frequencies. Contribution - this work is a part of a comprehensive program of plasma research for the development of an X-ray radiation source for simulation of nuclear weapon effects, the development of advanced electromagnetic weapons (laser and particle beams), the development of space and ionospheric communications, and the development of countermeasures.

This project will investigate the interaction of a high-power microwave radiation with a plasma beam. Specifically - (a) it will measure the microwave field along the axis of the plasma beam and radially and determine the phase velocity and attenuation, (b) it will compare the measurements with the theoretical results of the linear cylindrical plasma mode, (c) it will determine the balance of ionization versus the crossfield diffusion necessary for beam maintenance, (d) it will study the relation between the ion wave instability and the maintenance of the beam, (e) it will extend the foregoing to the high-power regime and higher neutral background pressure, (f) it will explore the capability of the axial magnetic field in maintaining the beam.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0031, TRANSITIONAL AND TURBULENT BOUNDARY LAYERS OVER HYPERSONIC REENTRY VEHICLES

M.S. HOLDEN, Calspan Corporation, *Buffalo*, *New York* 14221 (DF042630; F44620-76-C-0037)

Air Force function - aerospace vehicles (ABRES). Deficiency -ablating nose tips for reentry bodies having high ballistic coefficient develop unstable and asymmetric aerodynamic shapes with unacceptably high heating rates and aerodynamic performance. Objective - wind tunnel observations of oscillating flow phenomena on ablated nose shapes have been made at Calspan and elsewhere to determine the parametric boundaries between stable and unstable flows and the magnitude of pressure and heating rate fluctuations. These data are to be analyzed in further detail, and additional measurements in the hypersonic shock tunnel will be made in order to gain as much detailed understanding as possible of the many interacting flow features present in these nose tip flows. How contributes - once the cause and effect relationships among design geometry, ambient flow conditions, heating rates, and flow instability features are well understood, it can be a matter of rational engineering design to optimize heat protection and aerodynamic performance of the nose tips. Until then, the success of designs depends partly on a certain amount of luck.

The Calspan 96 inch hypersonic shock tunnel will be used to test models of appropriate nose tip configurations at Mach numbers of 9 and 13 and Reynolds numbers up to 80 million per foot. Detailed pressure and heat transfer distributions will be made as well as force tests on selected nose tip shapes. Effects of roughness, angle of attack, nose tip asymmetry as well as particle-induced heating augmentation will be examined. The data will then be analyzed and correlated with other data, including what is available from flight test to delineate the mechanisms responsible for the observed phenomena.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0032, NOVEL CHEMICAL LASER SYSTEMS

T.A. COOL, Cornell University, School of Engineering, *Ithaca*, *New York* 14850 (DF037150; AF-AFOSR-2550-73)

AF function - future Air Force operations in reconnaissance, communications, weaponry, and other areas require new laser systems of varied output frequencies of shorter wavelength, increased power at lower weight. Deficiency - a lack of suitable chemically pumped lasers of high efficiency with output wavelengths of less than two micrometers. Objective - examine various techniques in an attempt to develop a prototype electronic transition laser pumped directly by exothermic chemical

reactions. The goal is to produce laser action on systems that radiate in the near IR, visible or ultraviolet regions of the spectrum. How work contributes - various techniques are formualted and developed to produce metal atom vapors for reactions with oxidizers. The exothermic reactions produce excited states of molecules and atoms that may result in population inversion - a prerequisite for lasing action.

Use of high-temperature oven, shock tube, nozzle array and laser cavity to study exoergic chemical reactions involving metal atoms and oxidizers including thallium, scandium and yttrium among others to look for laser action from electronic transitions in atom and molecular systems. Examine the possibility of employing the experimental apparatus to produce a pulsed rare-gas monohalide laser.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0033, DESIGN OF A MICROPROCESSOR-BASED HIGH SPEED SPACE BORNE MESSAGE SWITCH
M. AROZULLAH, Clarkson College of Technology, School of Engineering, *Potsdam, New York* 13676 (NSG 3191)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

4.0034, IN-HOUSE MEASUREMENTS PROGRAM
D.W. HANSON, U.S. Air Force, Rome Air Development Ctr., *Rome, New York* 13440 (DF740510)

Air Force function - this effort supports research to improve the space object characterization and mission assessment capability of the USAF. Deficiency - high-resolution imagery of space objects cannot be obtained from ground-based sensors, due to optical phase aberrations caused by turbulence in the earth's atmosphere. Mission assessment and identification of spacecraft must therefore depend on other than high-resolution imagery. Objective - to measure atmospheric and optical propagation parameters. How research contributes - the data obtained will be used to verify existing theoretical analyses and to provide design parameters for compensated imaging systems.

Theoretical considerations will be used to establish a priority on parameters to be measured. Existing scientific packages at the Verona test site will be used to make the required measurements. The coelostat and one meter telescope gives the Verona facility the capability of extremely accurate positioning, limited tracking, and making both up and down path measurements.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Rome Air Development Center

4.0035, INVESTIGATIONS INTO THE GEOMETRY OF STRAIGHT AND SPIRAL BEVEL GEARS
R.L. HUSTON, Univ. of Cincinnati, School of Engineering, *Cincinnati, Ohio* 45221 (NSG 3188)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

4.0036, STUDY OF REYNOLDS STRESS EQUATION FOR PREDICTION OF FLOW CHARACTERISTICS OF FREE JET
Y.G. TSUEI, Univ. of Cincinnati, School of Engineering, *Cincinnati, Ohio* 45221 (DF048510; AF-AFOSR-3311-77)

AF function - advanced combustor technology. Deficiency - lack of knowledge of turbulent flow field within a ramjet dump burner. Objective - develop a computer code which is fast and efficient for calculating the axisymmetric flow into a dump burner that includes turbulent intensity as well as turbulent shear stress. How work contributes - better knowledge of the flow fields through combustors will allow improved design of the ramjet combustion systems. Without the improved flow fields it is not possible to visualize the convection and diffusion of the chemical species needed to obtain combustion efficiency and control heat transfer in the radial direction. This proposal will provide a simplified flow predictive method and will add turbulent intensity to the flow field parameters.

A numerical program will be developed and tested for the prediction of free jet flow characteristics. The program will include terms to predict the decay of centerline velocity, turbulent shear stress, and turbulent kinetic energy generation and dissipation.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0037, LASER ATMOSPHERIC ABSORPTION STUDIES
R. LONG, Ohio State University, School of Engineering, *Columbus, Ohio* 43212 (DF739710; F30602-76-C-0058)

The objective of this effort will provide an accurate laboratory measurement of the transmission characteristics of candidate high-energy systems for selected atmospheric absorbers and meteorological conditions.

To accurately assess the transmission losses and the propagation constants required for extrapolated computation of these losses, the contractor will utilize several techniques. Direct measurement of absorption coefficients shall be made in a white cell and in an acoustic spectrophone. These measurements shall be compared with and used to update synthetic spectra.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Rome Air Development Center

4.0038, ELECTRICALLY SMALL ANTENNAS 13331-EL
C.H. WALTER, Ohio State University, School of Engineering, *Columbus, Ohio* 43212 (DA0S5575; DAAG29 76 G0067)

To study theoretical and experimental aspects of electrically small antennas. Relevance - the results will be applicable to reduced silhouette antennas such as used on manpack, vehicles, helicopters, antenna camouflage and antennas mounted on missiles or projectiles.

Determinations will be made of (1) limitations of electrically small antennas, and trade-offs between size, shape, signal to noise ratio, efficiency, pattern, power handling and bandwidth, and (2) effects of nearby conducting and dielectric matter.

SUPPORTED BY U.S. Dept. of Defense, Army Materiel Development & Readiness Command, Army Research Office

4.0039, CHARACTERIZATION OF ION IMPLANTED COMPOUND SEMICONDUCTORS
E.T. RODINE, Systems Research Labs. Inc., *Dayton, Ohio* 45432 (DF104990; F33615-76-C-1166)

Present solid-state microwave and opto-electronic devices employed in AF avionics systems require improved reproducibility and reliability. One specific application of output from this research is to improve the performance of such devices by applying ion implantation to the material preparation and device fabrication. The objectives of this experimental program are to characterize ion-implanted epitaxial and substrate compound semiconductors such as gallium arsenide (GaAs), indium phosphide (InP), gallium phosphide (GaP), and other related compounds and to assess the utility of ion implantation techniques for device fabrication and development of bulk and thin-film GaAs, InP, and GaP materials for microwave, high-speed logic and electroopitcal device applications.

The work will utilize ion implantation as a principal technique for doping materials with a wide variety of ions in a reproducible manner. This is a thorough program in which (1) the pre-implanted material is carefully characterized, (2) the implantation process is precisely controlled and analyzed with suitable techniques as needed, (3) the implanted layers are characterized by capacitance-voltage (c-v), differential Hall, distributed resistance capacitance (RC) measurements and deep level trap spectroscopy (DLTS). Emphasis will be placed on the investigation of the electrical properties of the implanted layers which are pertinent to device fabrication. Different contacting strategies for the production of high quality ohmic contacts such as the production of highly doped contacting layers by implantation and the use of heavy ion surface radiation damage as a prelude to contact formation will be evaluated.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Avionics Lab.

4.0040, INVESTIGATION OF METHODS OF PLASMA EXCITATION

M. LAKE, Univ. Energy Systems Inc., *Dayton, Ohio* (DF458870; F33615-75-C-1082)

AF function - communication, illumination, weaponry. Deficiency -need for high-energy density controllable plasma excitation methods. Research - experimental analysis of methods of plasma excitation. How research contributes - has provided measurements of total ionization cross sections, cross sections of metastable specie transitions to other excited states, characteristics of microwave excitation methods, and measurements of electron energy loss in excited gases.

The research is conducted using three existing experimental configurations located in Bldg 450, WPAFB. They are - a cross-beam excitation analyzer (CBEA), a flowing afterglow facility, and a low-energy electron monochromatic analyzer. In addition, a modified CBEA has been built by the contractor to provide the cross-section measurements of transitions between excited states.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aero Propulsion Lab.

4.0041, THIN-FILM ACOUSTOOPTIC DEVICES

C.S. TSAI, Carnegie Mellon University, Inst. of Technology, *Pittsburgh, Pennsylvania* 15213 (DF046900; AF-AFOSR-3187-77)

AF function - microwave solid-state electronic devices are essential components of Air Force electronic countermeasures, communications and signal processing systems. Opportunity - it is now recognized that integrated/fiber optics will have important applications in wideband multichannel communication and information processing. In order to achieve applications in these areas, high-performance thin-film active devices are needed, and thin-film acoustooptic devices appear to be very promising for this purpose. Objective - the main objectives of this research are to investigate several thin-film acoustooptical devices which have potential for application to future wideband multichannel integrated/fiber optic signal processing and communication systems. How work contributes - specifically, this research will investigate several interaction mechanisms between surface acoustic waves (fixed or variable frequency) and guided light waves (fixed or variable frequency) in order to deflect or steer the light beam. The work will also consider wideband electrical matching to multiple surface acoustic wave (SAW) transducers and a tunable photodetector using SAW.

The proposed research problem will consist of the seven subareas described below. Very high speed light beam deflection and switching. Theoretical and experimental studies will be used to determine the various device and systems aspects of the deflectors with specific reference to high-speed deflection/switching. Spectrum analysis of very wideband RF signals. Implementation of wideband multiple SAW transducer configurations with lithium niobate, gallium arsenide and silicon will be examined. Wideband rf signal processing. The objective here is to determine the ultimate performance figures of such a convolver with respect to dynamic range and time-bandwidth product. Wideband electrical matching to multiple SAW transducers. Studies will be made to obtain better electrical matching to the multiple transducer needed for their wide bandwidth applications in the first three sub-areas. Optical time-multiplexing and demultiplexing. Experiments using various kinds of optical waveguide materials/structures will be carried out in order to determine the ultimate capability of the thin-film a-o sequential switch with respect to optical time-multiplexing/demultiplexing in multichannel fiber/integrated optical communications systems. (Text abridged.)

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0042, AFAPL J85-5 RADIATION MEASUREMENTS

W.T. BERTRAND, Arnold Research Org. Inc., *Tullahoma, Tennessee* 37389 (DF420954; F40600-75-C-0001)

The objective is to obtain afterburner plume infrared emissions measurements on a J85-5 engine using ten fuels with JP-4 as the baseline fuel. Narrow-line ultraviolet absorption measurements of NO will also be made.

The effort will involve approximately ten days of experimental testing of AFAPL at various power settings using JP-4 fuel as a reference and ten test fuels. Relative radiation intensities will be established for the various fuels.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Arnold Engineering & Development Center

4.0043, NEW MEMORY DEVICE STRUCTURES

G.A. HARTSELL, Texas Instruments Incorporated, *Dallas, Texas* 75222 (DF096850; F33615-74-C-1054)

In Mar 76, Samso/SZS added funding to this contract which would be used to fabricate and test CCD signal processing circuits for a scanning focal plane application. The objective was to determine whether the radiation hard CCD structure, tested previously on other program tasks, could be adapted to perform a useful device function for space applications.

In order to assess the potential of the radiation hard CCD structure for space applications, a composite test device will be fabricated and evaluated in a simulated focal plane operation. The composite test device will simulate a 3-line IR sensor and will extract the x-y coordinates of a point object in its FOV, as well as discriminating betweeen true signals and gamma-induced noise.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Avionics Lab.

4.0044, PENETRATOR GROUND COUPLING EXPERIMENT

Y. NAKAMURA, Univ. of Texas, Graduate School, *Galveston, Texas* 77550 (NSG 2310)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

4.0045, STUDIES OF TRANSIENT DISCHARGES

M. GUNDERSEN, Texas Tech University, School of Engineering, *Lubbock, Texas* 79409 (DF049140; AF-AFOSR-3365-77)

AF function - the electrical breakdown of gases plays an important role in most applications of pulse power technology. Breakdown is important in switching and for the load itself (laser or plasma). Switches temporal behavior and proper characterization of the electrical load have been difficult to characterize in a fundamental way because of their nature. The mechanisms of laser induced and electron beam initiated spark gap breakdown need to be characterized from a fundamental point of view. Opportunity - recent developments in spectroscopy, including coherent and spontaneous Raman, fluorescence, gating techniques, and laser probes, make it possible to measure the population of specific constituents and their excited states. It is possible to investigate small effects which lead to arc formation. Objective - concentrations and states of excitation of both atomic and molecular species in discharges will be monitored with both temporal and spatial resolution. Contribution - for switches temporal behavior, jitter, breakdown characteristics, repetition rate effects and electro-erosion of spark gap electrodes are important. Proper characterization of the electrical load is important for good pulser design, but presently the basic physical mechanisms occurring in such discharges are insufficiently understood. The mechanisms of spark gap breakdown will be characterized.

Initially, discharges between parallel plate electrodes in simple gases will be investigated. The initial electrons in the avalanche will be provided by irradiating a spot on the cathode with a pulse of ultraviolet light either from a laser or a fast spark. In high current electrical discharges in gases at moderate and higher pressure such as found in many pulsed power switching devices the discharge is an arc and is confined to a narrow channel. Formation of this discharge channel will be studied to understand the physical mechanisms involved. The detailed nature of these discharge channels and their formation is reponsible for the electrical characteristics of these switching devices. A major problem in constructing high repetition rate switches is the vibrationally and electronically excited molecules remaining in the gap region from the previous pulse. The remnant excitation will be studied to determine what excited species are present in the after-

glow and what effect they have on the following pulse. (Text abridged.)

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0046, RADIO PROPAGATION VIA TRANSPONDER
T. TROST, Texas Tech University, School of Engineering, *Lubbock, Texas* 79409 (DF049280; AF-AFOSR-3374-77)

AF function - a UHF transponder will be flown by the AF in a parachute-borne instrument package over southern New Mexico in the summer of 1977. The parachute and instrument package will be launched from the White Sands Missile Range by a NASA rocket. While in flight, the transponder will relay signals transmitted to it from a ground station. It is proposed to design and operate receiving equipment at two distant sites (Lubbock, TX and Wichita Falls, TX) to receive the transponder signals and determine the signal characteristics as a function of the altitude and horizontal travel of the parachute. This will allow experimental verification of predicted radio propagation effects. Opportunity - the scheduled flight provides an excellent opportunity to carry out theoretical predictions of propagation and test them directly by experiment. Objective - an experimental investigation of the propagation characteristics of radio signals transmitted between two ground stations via a parachute-borne transponder will be conducted. Contribution - the work will involve the calculation of the expected signal strength vs. parachute location, the instrumentation of two radio receiving sites, including the design and construction of custom receiving antennas, and the recording and analysis of the signals received via the transponder.

To have a theoretical basis for evaluating the experimental results, the signal-to-noise ratios to be expected at the receiving sites as a function of parachute location and estimated meteorological conditions will be calculated. Two receiving antennas, one for each site, will be designed and tested; the antenna types to be considered are the helix, corner reflector and YAGI. The radio frequency to be used is 387.2 mHz. The antennas will be connected to receivers with outputs recorded on analog tape. Both the carrier level and the modulation (AM) will be recorded, along with the time of day from WWV transmissions at 10 mHz. The signal strength recordings will then be compared with the calculated signal strengths and differences interpreted in terms of the meteorological variables which affect signal propagation.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0047, CORONA FROM ICE, THUNDERSTORM ELECTRIFICATION AND LIGHTNING
J. LATHAM, Victoria Univ. of Manchester, *Manchester, England, United Kingdom* (DF049960; AF-AFOSR-3429-77)

AF function - lightning is a hazard to aircraft materials and avionics as well as computer facilities. The power levels and extraneous signals produced can be devastating. Deficiency - little is known of the charging and discharge mechanisms of clouds. Laboratory and field measurements disagree. Objective - to do laboratory and field investigations of the charging mechanisms in supercooled ice and water collisions and of the contribution of corona on ice crystals to a discharge mechanism. How work contributes - will add to our knowledge of cloud charging mechanisms and contribution of ice corona to cloud discharge, lightning.

Laboratory work on ice and droplet collisional charging and ice coronal ionization production. Field experiments in cloud charging regions and charge transfer.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0048, MIXING-CHEMISTRY INTERACTION IN CONTINUOUS COMBUSTION
D.T. PRATT, Utah Higher Education System, School of Engineering, *Salt Lake City, Utah* 84112 (ENG76-84533)

Two distinct analytical methods of computer modeling of high-intensity, turbulent, backmixed continuous combustion will be developed further, and the resulting models will be compared with experimental flame stability limits, heat-release and pollutant formation rates in both a modified laboratory jet-stirred reactor, and developmental prototypes of low-emission automotive and aircraft gas turbine combustors. The two methods are: 1. Solution of the governing partial differential equations for conservation of mass, momentum, thermal energy and mass fractions of chemical species, utilizing conventional finite difference schemes, turbulence models and turbulent reaction models. 2. Coalescence/dispersion or 'Monte Carlo' stochastic mixing/reaction model. The two methods will also be combined; in the hybrid model, method 1 will be used to predict residence time distributions and spatial distributions of turbulence parameters, which will in turn be utilized as required input to model 2 simulation. The models will be compared with experimental data on blowout limits, stationary-state temperature and species concentrations obtained with the cooperation of investigators at the Washington State University. Similar, although less-detailed, data from low-emission gas turbine combustors will be obtained from the General Motors Research Center and the AVCO-Lycoming Corporation.

SUPPORTED BY U.S. National Science Foundation, Div. of Engineering

4.0049, HYPERSONIC VISCOUS FLOWS OVER THREE-D BODIES AT ANGLE OF ATTACK
C.H. LEWIS, Virginia Poly. Inst. & St. U., School of Engineering, *Blacksburg, Virginia* 24061 (NSG 1520)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

4.0050, AERODYNAMIC FORCES EXERTED ON AN ARTICULATED HUMAN BODY SUBJECTED TO WINDBLAST
D.J. SCHNECK, Virginia Poly. Inst. & St. U., School of Engineering, *Blacksburg, Virginia* 24061 (DF048300; AF-AFOSR-3296-77)

AF function - the Air Force operational environment involves exposure to a wide variety of mechanical forces including flail and impact. These forces are of special significance in relation to the incidence of ejection from high-performance aircraft where the probability of disabling injury is unacceptably high. Deficiency - this research will provide input data need for an elaborate bimechanical computer model of the human body which has been developed to determine the stresses, strains and injury mechanisms due to windblast during ejection. Objective - development of the theory of windblast as initiated under USAF/ASEE summer faculty research program, examine the contribution of flow separation to limb flail during ejection, provide data for wind tunnel tests and for the articulated total body model studies at AMRL. How research contributes - this research will contribute directly to subarea 1.6, 'crew safety and effectiveness in mechanical force environments.'

The research will elucidate the contribution of flow separation to the factors which initiate limb-dislodgment forces during ejection. These data will provide input to the AMRL articulated total body model, which will analytically describe the dynamics of ejection.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0051, DETECTION OF AIRBORNE INTRUDER WITH SCANNING PASSIVE INFRARED
A.C. JOHNSON, U.S. Army, Mobility Eqp. Res. & Dev. Com., *Fort Belvoir, Virginia* 22060 (DA0N3581)

The technical objective is to determine the effectiveness of scanning passive infrared sensing in the detection of airborne intruders. Such an intruder may be borne by parachute, balloon, hang glider, helicopter or back-pack rocket depending on his mobility requirements. The problem is most acute at night.

A scanning passive infrared detector which views the sky background against the horizon is the subject of this research. IR detectors designed for the 3-5 micron, 5-8 micron, and 8-14 micron ranges will be purchased and placed in a scanning sensor.

Data will be collected on the detectability of helicopters, other aircraft, and parachutists.

SUPPORTED BY U.S. Dept. of Defense, Army, Mobility Equipment Research & Development Command

GEOSCIENCES

Includes Geosciences (general); Earth Resources; Energy Production and Conversion; Environment Pollution; Geophysics; Meteorology and Climatology; and Oceanography. For Related Information See Also Space Sciences.

5.0001, THEORETICAL INVESTIGATION OF THE MECHANICS OF STRIKE SLIP FAULTING IN THE ANELASTIC PROGRAM
H.J. MELOSH, Calif. Inst. of Technology, Graduate School, *Pasadena, California* 91109 (NSG 5267)

SUPPORTED BY U.S. National Aeronautics & Space Admin.; Office of Organization & Management, Office of University Affairs

5.0002, CALIBRATION OF SATELLITE DATA FOR INPUT TO DISTRIBUTED PARAMETER HYDROLOGIC MODELS
J. DOZIER, Univ. of California, School of Letters & Science, *Santa Barbara, California* 93106 (NSG 5262)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

5.0003, X-BAND DOPPLER
LIEDTKE, U.S. Dept. of Commerce, Environmental Research Labs., *Boulder, Colorado* 80302 (8G120379)

PROJECT OBJECTIVE: Modify and test an X-Band radar for meteorological measurements from an airborne platform.

SUPPORTED BY U.S. Dept. of Commerce, National Oceanic & Atmospheric Admin., Environmental Research Labs.

5.0004, COHERENT LIDAR SYSTEM
P. MANDICS, U.S. Dept. of Commerce, Environmental Research Labs., *Boulder, Colorado* 80302 (RAA74325)

PROJECT OBJECTIVE: Develop infrared pulse coherent lidar system to measure atmospheric winds and species remotely.

CURRENT YEAR PLAN: Initiate development of pulse coherent lidar hardware.

SUPPORTED BY U.S. Dept. of Defense, Air Force

5.0005, HURRICANE RESEARCH
R.C. SHEETS, U.S. Dept. of Commerce, Environmental Research Labs., *Boulder, Colorado* 80302 (8C351331)

PROJECT OBJECTIVE: To increase the understanding of the hurricane structure, interactions, and processes ranging from the microscale to the synoptic scale. These studies are aimed at improving the predictability through better parameterizations, data inputs and/or formulations for models or recognizing significant features leading to predictable storm development or structural changes.

CURRENT YEAR PLAN: Continue investigations of the boundary layer and air-sea interaction processes in the hurricane environment using aircraft data. Continue investigations of the convective structure of hurricanes using high-resolution satellite data and airborne and land-based radar. Continue investigations of the thermal structure and short-term natural variability of hurricanes. Continue investigations of the microphysical processes in hurricanes.

PROGRESS REPORT: The microphysical structure of selected clouds in Hurricanes Bonnie (Eastern Pacific), Belle, Frances, Emmy, Gloria (1976) were investigated and partially documented. Obtained data using new aircraft and instrumentation in Hurricane Anita (1977). Sea surface and subsurface measurements indicated existences of warm eddies which may have contributed to the rapid deepening of Anita. Subsequent cold upwelling was documented which may have contributed to the lack of development of Tropical Storm Babe in the wake of Anita. First time airborne digitized radar data were obtained in a mature hurricane (wind speeds exceeded 80 m/sec).

SUPPORTED BY U.S. Dept. of Commerce, National Oceanic & Atmospheric Admin., Environmental Research Labs.

5.0006, MAINTENANCE AND FLIGHTS OF BALLOON-BORNE STRATOSPHERIC MEASURING PACKAGE
D. MURCRAY, Univ. of Denver, School of Arts & Sciences, *Denver, Colorado* 80210 (DA0L4440; DAAD05-76-C-0740)

To use several measuring packages which have already been built by the contractor to make in situ balloon-borne measurements of the minor constituents, both ions and neutral molecules, of the stratosphere. The contractor will maintain and fly these packages.

The contractor will prepare existing balloon-borne infrared and mass spectrometer packages for balloon flights, fly the packages, and reduce and analyze the data. There can be a reasonable amount of rebuilding and/or modification of the packages, but the contruction of wholly new instruments is not included. Two ballooning expeditions are planned for FY 75, one for the continental United States in the Fall of 1974 (designated COSMEP II), and one in the Fairbanks, Alaska, area in the Spring of 1975 (COSMEP III). C–SMEP III is contingent on the receipt of additional funding.

SUPPORTED BY U.S. Dept. of Defense, Armament Research & Development Command, Ballistic Research Labs.

5.0007, STUDY OF ATMOSPHERIC MECHANISMS
UNKNOWN, Center for Environ. & Man Inc., *Hartford, Connecticut* 06120 (FA77WA-4055; FA160410 (TRAIS NO.))

Perform a study of Atmospheric Mechanisms and accomplish the following tasks: (1) Exhaust trail diffusion and chemistry; (2) Distribution of trace constituents; and (3) Meteorological considerations.

SUPPORTED BY U.S. Dept. of Transportation, Federal Aviation Admin.

5.0008, AURORAL ZONE IONOSPHERIC PHENOMENA USING SATELLITES
A.N. LUNDBAK, Danish Meteorological Inst., *Copenhagan, Denmark* (DF277740; AF-AFOSR-3149-77)

AF function - communications/navigation. Deficiency - signal fading, range errors, diffraction errors. Objective - measure ionospheric parameters causing deficiencies. How research contributes -results used to develop predictive models of scintillation and total electron content for auroral region.

VHF and UHF signals are recorded and analyzed by grantee. Angle of elevation effects computed from DNA and meteorological satellites. Analyses and reduced data are delivered to AFGL for inclusion into auroral zone model being constructed for AWS systems useage.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0009, REMOTE SENSING SURVEYS FOR AGRICULTURAL STATISTICS
W.H. WIGTON, U.S. Dept. of Agriculture, *Washington, District of Columbia* 20250 (0016918; RD-3)

OBJECTIVE: Develop techniques of automated data extraction and statistical methods for using remote sensing data recorded as photographs or multispectral imagery, with reference to field crops, fruit trees and livestock estimates.

APPROACH: Conduct experiments using ground photography, aircraft and satellite imagery in cooperation with universities. Automated classification programs will be developed to

identify crop species and to assess crop damages. Automated discrimination programs will be developed to make fruit counts on citrus and deciduous tree crops. Ground truth will be obtained on a sample basis as needed to interpret and evaluate the results of sensor data. If remote sensing data are a feasible source of supplementary information, statistical methods will be developed for collection, interpretation and analysis.

PROGRESS: Our initial LANDSAT (formerly called ERTS) investigation and report was completed. A second investigation testing the feasibility of the first study is underway. The software for the analysis is complete and documentation is in progress. Illinois 1975 data is being analyzed at BBN in Boston and whole scenes are being classified (7.6 million pixels) in about three minutes on the Illiac IV computer at NASA, Ames in California. The objective is to improve the crop acreage estimates that are generated from the area sampling frame. Initial results of the western third of Illinois indicate that major reductions in variances are possible and that processing is efficient. Also, estimates of crop acreages of much smaller areas can be estimated using LANDSAT than without it. So far we have papers on methodology and initial analysis results. We still have yet to process in near real time.

SUPPORTED BY U.S. Dept. of Agriculture, Statistical Reporting Service, Crop & Livestock Estimating

5.0010, ATMOSPHERIC SCIENCES, GEOPHYSICAL EFFECTS PROFILE OF ENERGETIC IONS IN THE ATMOSPHERE

R. SILBERBERG, U.S. Navy, Res. Laboratory, *Washington, District of Columbia* 20375 (DN580199)

To determine the heavy-particle radiation spectrum, especially for highly ionizing nuclei, at different levels within the upper atmosphere, and to apply the data on these penetrating particles in estimating their potential hazards to high-altitude missions.

A computer code will be developed to transport the heavy particle radiations through the magnetosphere and into the atmosphere in successive steps, until the particles come to rest or are lost through nuclear interactions. Existing data on energy spectra, composition, geomagnetic effects, energy loss, and nuclear transformations will be utilized. Experiments will be carried out to supplement the limited data that now exist on fragmentation of heavy nuclei in air. The goal of this project--the assessment of heavy-particle radiation effects--involves application of the results to an operational system, such as a high-altitude aircraft and its crew.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Research Lab.

5.0011, PHOTOSYNTHETIC CARBON REDUCTION OF MARINE GRASSES EXPOSED TO ULTRAVIOLET-B IRRADIATION

G.N. WELLS, Florida Inst. of Technology, School of Science & Engin., *Melbourne, Florida* 32901 (NAS 9-15516)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

5.0012, ATOMIC OXYGEN STIMULATED OUTGASSING EXPERIMENT FOR THE LONG DURATION EXPOSURE FACILITY PHASES I AND II

R.L. SCOTT, Southern Univ. A & M College, School of Engineering, *Baton Rouge, Louisiana* 70813 (NAS 1-15335)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

5.0013, RESEARCH OF THERMAL REGIME OF THE UPPER MANTLE

B.D. MARSH, Johns Hopkins University, School of Arts & Sciences, *Baltimore, Maryland* 21218 (NSG 5269)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

5.0014, GEOPHYSICAL PREDICTIONS FROM SOLAR RADIO BURSTS ENVIRONMENT

J.P. CASTELLI, U.S. Air Force, Geophysics Laboratory, *Bedford, Massachusetts* 01730 (DF274870)

AF function - communications and surveillance. Deficiency - there is a need to identify spurious signals in surveillance systems as man-made or natural phenomena. Forecasts of solar geophysical events which disturb the ionosphere have been unreliable and inadequate. Research -maintain a real time multifrequency solar radio patrol with moderate to low angular resolution at Sagamore Hill between 24 and 35000 mHz for operational usefulness in providing data alerts. Assist in completion of AF solar radio network. Develop correlations (identify signatures) between solar radio and geophysical phenomena to forecast proton events. Develop automation and specialized equipment to satisfy operational needs. How research contributes - radio emission is a prime indicator of the status of solar activity and the degree to which AF systems operating in the near space environment are likely to be affected. Forecast techniques are being developed from solar radio burst signatures.

The characteristics of bursts are being studied to develop a technique for the early identification of proton flare regions. The radio burst characteristics of lesser proton regions are emerging. Different parts of the burst spectrum show promise in prediction of electron and proton energy distribution. Correlations are being performed with EUV and X-rays for prediction of ionospheric disturbances which disrupt communication. Ground-based solar radio data are quantitative, available in real time. The radio signatures of solar disturbances often provide the first reliable information on the importance of an event and allow for warning of subsequent related effects. This data base is being used for specifying the neutral atmospheric density relevant in satellite 'drag' considerations.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0015, REFERENCE ATMOSPHERES

A.E. COLE, U.S. Air Force, Geophysics Laboratory, *Bedford, Massachusetts* 01730 (DF244060)

Air Force function - design and operation of aerospace vehicles. Deficiency - distribution, as well as time and space variations, of the thermodynamic properties of the atmosphere for levels up to 100 km must be known in order to establish design criteria and operational procedures for various types of reentry vehicles. Objective - develop mathematical models of the atmosphere which portray latitudinal, longitudinal, monthly, and day-to-day variability of pressure, density and temperature at levels up to 100 km. How research contributes - a more detailed knowledge of atmospheric structure below 100 km will be useful in targeting and in design of systems for intercepting ballistic missiles.

Analyze and evaluate all observations of the thermodynamic properties of the atmosphere between 30 and 100 km to insure a uniform data sample. Eliminate data that are biased or in error due to faulty sensors. Develop mathematical models of the thermodynamic properties of the atmosphere between the surface and 100 km which provide a complete description of the monthly, latitudinal and longitudinal variations in atmospheric structure. Include models which depict conditions during 'sudden warmings' of the stratosphere and mesosphere in arctic and sub-arctic regions during the winter months. These models will replace the U.S. Standard Atmosphere Supplements, 1966, which are used by all aerospace engineers and designers in the United States as design criteria. The new models will present a more complete description of the variation in atmospheric structure for levels up to 100 km and will be called U.S. Reference Atmospheres.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0016, FALLING SPHERE DENSITY MEASUREMENTS
A.C. FAIRE, U.S. Air Force, *Bedford, Massachusetts* 01730 (DF248820)

AF function - ballistic nuclear weapon delivery. Deficiency - missile and decoy trajectories and low-altitude satellite orbits cannot be determined accurately due to inadequate data on temporal and spatial variations of density at critical altitudes. Objective - improved rocketborne falling sphere techniques will be employed to determine atmospheric density between 40 and 170 km. How research contributes -improved capability to calculate accurate ICBM rv and decoy trajectories and low-altitude satellite orbits and reentry.

Atmospheric density will be determined at a number of locations as required. This will include measurements near the reentry corridor at Kwajalein Missile Range using high-precision 7- and 10-inch pzl densitometers (rigid falling spheres) instrumented with unique ultrasensitive triaxially configured piezoelectric accelerometer systems. The sphere payloads will be launched onboard appropriate two-stage sounding rockets. The 7-inch sphere payloads can be used to determine density between 40 and 120 km with medium performance sounding rockets, while the 10-inch payload can determine density between 40 and 170 km. This is a unique capability that will be essential for comparing rocketborne density data with observations from onboard satellite instrumentation such as the SSD package on the DMSP satellite. A significant part of the effort will be directed toward improving the accuracy and reliability of both the 7-inch and 10-inch falling sphere oystems. The 10-inch pzl densitometer is operational but is continually being upgraded with new state-of-the-art electronic technology. More work is required to develop an operational 7-inch pzl densitometer that will provide a more cost-effective system for high-precision density measurements up to 120 km.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0017, HIGH-ALTITUDE ENVIRONMENTAL SPECIFICATION
H.B. GARRETT, U.S. Air Force, Geophysics Laboratory, *Bedford, Massachusetts* 01730 (DF249050)

AF function - AF communications satellites at synchronous orbit are degraded by satellite charging induced by the plasma environment. Deficiency - the space environment during periods of satellite charging is not sufficiently defined. Objective - to plan for and conduct a rapid interpretation of the environmental data returned by the SCATHA satellite in conjunction with the SCATHA engineering sensors so that adequate design criteria might be developed to prevent degradation of future satellite communications systems. How research contributes -understanding of the satellite charging phenomenon is necessary so that steps may be taken to prevent damage to satellites from electrostatic discharges (ESD). Knowledge of the geosynchronous environment is needed to interpret the causes of spacecraft charging and to complement efforts aimed at computer simulations of the spacecraft-environment interaction.

Data from the ATS-5 satellites will be analyzed to produce an environmental atlas. This atlas will consist of a statistical description of the ambient geosynchronous plasma. Plans will be made to incorporate the SCATHA (satellite charging at high altitudes) satellite data into a final comprehensive specification of geosynchronous and near-geosynchronous plasma environment. This final atlas will be the basis of a statement to be included in AF contractor's SOW's.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0018, CEILING MEASURING EQUIPMENT AND TECHNIQUES
E.Y. MOROZ, U.S. Air Force, Geophysics Laboratory, *Bedford, Massachusetts* 01730 (DF243780)

AF function - navigation and weapons delivery functions of strategic, tactical, air defense, and airlift forces. Deficiency - the Air Force lacks an effective means to record and display cloud height data, and to automatically determine sky cover. Objective - the objective is to develop an automated laser ceilometer and data processor to determine, record and display cloud height data and to provide information for automatically determining sky cover. How development contributes - an automated laser ceilometer will provide for improved safety in airport operations and reduce the manpower requirement for making routine surface weather observations.

Tests will be conducted to evaluate the performance characteristics of a newly developed, prototype, eye-safe, erbium laser ceilometer. Operational requirements for automatically processing, recording, and displaying the ceiling height and sky cover information will be determined. The automated ceilometer will be operationally tested within the program to develop automated surface weather observations.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0019, LOW-ENERGY PLASMA OBSERVATIONS
R.C. SAGALYN, U.S. Air Force, Geophysics Laboratory, *Bedford, Massachusetts* 01730 (DF249210)

AF function - surveillance, communication, navigation, magnetospheric modelling and spacecraft charging. Deficiency -inadequate knowledge of the electrical properties of the magnetosphere and of the interaction of a satellite with the environmental plasma at synchronous altitudes. Objective - to design and fabricate instruments to measure the low-energy plasma (0 to 100 ev) environment of a synchronous orbit satellite to determine the role of low-energy particles in spacecraft charging. How research contributes - permits improved military space vehicle design for communication and surveillance systems, provides understanding of dynamical processes in the magnetosphere and contributes to the understanding and solution of spacecraft charging problems.

Low-energy plasma sensors will be flown on the spacecraft charging (SCATHA) P78-2 satellite. The sensors will measure and distinguish the major sources of low-energy particles contributing to the current flow to the spacecraft. In addition, the local spacecraft surface potential with respect to the plasma will be determined.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0020, ELECTRIC FIELDS IN THE IONOSPHERE AND MAGNETOSPHERE
M. SMIDDY, U.S. Air Force, Geophysics Laboratory, *Bedford, Massachusetts* 01730 (DF249360)

AF function - surveillance, communication, navigation, ionosphere and magnetosphere modeling. Deficiency - environmental electric fields produce plasma motions which degrade orbital prediction and tracking accuracy as well as limiting the use of velocity vector sensors (VVAS) for satellite and missile guidance systems. They also cause irregularities which seriously degrade electromagnetic propagation prediction progress. Nuclear burst debris is diffused by electric fields, modifying the radio blackout observation of the burst. Objective - FY77 - new instrumentation will be developed for environmental electric field and vehicle potential measurements at synchronous altitude and at rocket altitudes in the auroral zones. Analysis of results from past rocket flights will be completed, integrated with simultaneous particle and optical emission measurements, and prepared for publication. How research contributes - models of electric fields and currents in the ionosphere and magnetosphere will significantly improve AF prediction capability of electromagnetic propagation and nuclear burst debris radio blackout conditions. It will minimize errors in satellite and missile ephemeris and tracking prediction and will define operational and design parameters for velocity vector guidance sensors.

Electric field measurements carried out by means of rockets and satellites and analytical studies are carried out based on the results of these experiments. The global f region electric fields will be mapped and the influence of electric fields on spacecraft charging determined.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0021, ARIES ROCKET FLIGHT ENVIRONMENT
R.G. STEEVES, U.S. Air Force, Geophysics Laboratory, *Bedford, Massachusetts* 01730 (DF249750)

AF function - probing the aerospace environment. Deficiency or opportunity - the ARIES flight environment is largely unknown. Objective - gather in-flight environmental data for aries rocket payloads. How research contributes - provides data on boost and post boost phase of flight to set environmental design, testing, and operating standards for scientific instrumentation to be flown on ARIES.

A system will be designed and assembled independent of other rocket instrumentation to measure in-flight vibration and temperature data. Data gathered from a minimum of 3 vibration transducers will be analyzed after each of three flights. Critical temperatures will be measured and telemetered.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0022, HIGH-RESOLUTION SOLAR ACTIVITY INVESTIGATION
R.M. STRAKA, U.S. Air Force, Geophysics Laboratory, *Bedford, Massachusetts* 01730 (DF244740)

AF function - communication and detection. Deficiency - polar communications and detection systems are severely degraded by solar proton flares. Objective - to establish from ground-based radio observations, a technique for predicting which active regions are capable of producing proton flare. How research contributes - permits advance warning of the occurrence of a solar proton event which seriously affects AF missions in space, polar cap communications, and satellite orbit positions.

High-resolution observations of the intensity and polarization signatures of individual active regions in the wavelength range from 3cm to 8mm will be obtained and employed as a data base for the determination of a dynamic model of the development cycle of an active region. Time variations within this model will be investigated in order to identify pre-flare signatures. Proton flare prediction criteria will be developed, tested, and subsequently incorporated into SESS (AWS) operational procedures.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0023, TIROS-N MICROWAVE SOUNDING UNIT
D. STAELIN, Mass. Inst. of Technology, Electronics Research Lab., *Cambridge, Massachusetts* 02139 (9-115; 04-8-MO1-1)

OBJECTIVE: To investigate and solve many of the identifiable problems associated with the use of microwave technology on the TIROS-N Microwave Sounding Unit. These include the degradation of temperature retrievals due to variable surface emissivities, clouds, water vapor and precipitation and the full utilization of the information content in the MSU window channel relevant to estimations of water vapor and precipitation.

APPROACH: A software package for processing the TIROS-N MSU data at the grantee institution will be developed. This will enable experiments to be performed for evaluating the sensitivity of retrievals to such parameters. The software will be used in the solutions of the several known problems as they affect microwave soundings in general.

SUPPORTED BY U.S. Dept. of Commerce, National Oceanic & Atmospheric Admin., National Environmental Satellite Service

5.0024, CORONAL HOLE MODEL STUDY
G.L. WITHBROE, Smithsonian Institution, *Cambridge, Massachusetts* 02138 (DF248110; F19628-76-C-0281)

AF function - communications and navigation. Deficiency - communication fading, and timing errors. Objective - to model the solar source regions (coronal holes) of the high-speed solar wind streams which create disruptive geomagnetic disturbances. How research contributes - provides a quantitative measure of the mass and energy flow from the solar atmosphere which form the high-speed solar winds and degrade satellite sensors, satellite and ground-based communications systems, and decrease accuracies of navigation systems.

Radio, EUV and X-ray wavelength solar observations will be used as input parameters for generating models of the coronal holes. The temperature and density profile from chromospheric levels to coronal levels will be derived to determine gradients which provide a measure of the energy transfer. The association of coronal holes with recurrent geomagnetic storms will be examined.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0025, ELECTRONICS FOR ULTRAVIOLET SPECTROMETER
C.G. KUCZUN, Tri Con Associates Inc., *Cambridge, Massachusetts* (DF249990; F19628-77-C-0048)

AF function - vehicle tracking during flight and reentry, trajectory prediction, communication systems. Deficiency - present atmospheric models predict only slight variability of the density of the upper atmosphere below 200 km; however, empirical data show this conclusion to be incorrect and observations indicate density changes as great as 50 percent in both space and time at altitudes between 120 and 200 km. This altitude, important for Air Force operations, will be studied on a world-wide basis by density experiments aboard the DMSP satellites. The present work will support these experiments. Objective -in-situ measurements with rockets of atmospheric parameters to provide correlative data for comparison with photometric data from DMSP satellites. How research contributes - provides direct, low-altitude measurements of pertinent atmospheric properties as an aid in understanding the remote optical measurements made from DMSP satellites.

Contractor shall design, fabricate and test an electronics subsystem for a double-deck solar EUV spectrometer and auxiliary experiments (a UV photometer, a dayglow photometer and an electron analyzer), modify ground support equipment consoles for the spectrometer and the photometers, and assist in the preparation of the rocket payload for flight. Measurements will subsequently be made from a rocket in the altitude range between 120 and 200 km. Of the photoelectron flux, differential energy distribution for energies between 0 and 100 electron volts, of the radiance of nitrogen airglow at 3371 Angstroms and of the density and composition of the upper atmosphere as established by solar ultraviolet photon absorption rates.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0026, WIND AND TEMPERATURE SPECTROMETER FOR THE DYNAMICS EXPLORER SPACECRAFT
G.R. CARIGNAN, Univ. of Michigan, School of Engineering, *Ann Arbor, Michigan* 48106 (NAS 5-25002)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

5.0027, IONOSPHERIC INSTABILITY MECHANISMS
E. FONTHEIN, Univ. of Michigan, School of Engineering, *Ann Arbor, Michigan* 48106 (DF248360; F19628-77-C-0008)

AF function - surveillance, communication, navigation, ionosphere and magnetosphere modelling. Deficiency - inadequate knowledge of ionosphere plasma instabilities and transport coefficients for the design needs of Air Force systems. Objective - determine the relative importance of various possible instability mechanisms in the high-latitude ionosphere on the production of anomalous transport coefficients. Apply results to the solution of coupled continuity, momentum and energy equations and compare with satellite measurements. How research contributes - provide data essential to radar propagation predictions, provide data essential for the design and utilization of communication, guidance, and surveillance systems and provide understanding of dynamical processes in the ionosphere and magnetosphere.

Analyze and study the relative importance of a variety of instability mechanisms as a function of altitude in the high-latitude ionosphere.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0028, MESOSCALE VARIABILITY OF THE ATMOSPHERIC WIND FIELD BELOW 5KM 13474-GS

K.S. GAGE, Control Data Corporation, *Minneapolis, Minnesota* 55420 (DA0E9074; DAAG29 76 C 0010)

(1) To analyze a real and temporal wind variability from newly available, accurate, high-resolution wind measurements - and to resolve conflicting power law relationships in wind varibility theory under a variety of geographic and synoptic conditions. The results of this research will be useful in the validation of numerical mesoscale models planned for use in the Army automatic meteorological system being developed by ASL, and in atmospheric gases and particulate transport models of DPG. It also has application to the problem of wind correction for artillery fire and Army missile systems such as Lance, Pershing, general service rockets, etc.

(1) To record sequential wind soundings to an altitude of 5 km from a single launch point in order to investigate temporal wind variability on scales from 20 minutes to 12 hours; (2) to modify the wind measurement system to allow two balloons to be tracked simultaneously, and to record simultaneous wind soundings of pairs of balloons released from two separated launch points to explore the horizontal-space wind variability on scales up to 30 km.

SUPPORTED BY U.S. Dept. of Defense, Army Materiel Development & Readiness Command, Army Research Office

5.0029, REMOTELY SENSED CROP TEMPERATURE FOR WATER RESOURCES MANAGEMENT

B.L. BLAD, Univ. of Nebraska, School of Agriculture, *Lincoln, Nebraska* 68583 (B-044-NEB)

The prime objective of this research is to evaluate the use of remotely sensed crop temperature as a tool for the management of water resources. Subsidiary objectives for accomplishment of the primary goal include: (1) to determine under varying climatic and moisture conditions the temperature response of major agronomic crops and rangeland vegetation; (2) to test methods based on crop temperature and/or other readily measureable meteorological parameters for estimating crop water and heat stress conditions; and (3) to determine the feasibility of using crop temperature data as a guide for irrigation scheduling.

The dramatic increase in irrigated land in Nebraska and other subhumid-semiarid regions has caused great agricultural demand for water. The demand for water in the Great Plains is especially high because crops in this region use great quantities of water. This results not only because the amounts of radiative energy are relatively high but also because significant amounts of energy from advected sensible heat are transported into the region and consumed in the evapotranspiration process. Better management of water in this region is necessary to meet these increasing water demands. Proper scheduling of irrigation is one important management tool for improving the efficiency of water use. Crop temperature may serve as a guide to improved irrigation scheduling practices since it is a good indicator of the plant water status. Crop temperature may also be used to indicate the moisture status of non-irrigated fields and rangeland for evaluating the extent and severity of drought damage, for example. The advent of instrumentation to measure surface temperature for large areas from satellite and airborne platforms greatly enhances the value of crop temperature data as a tool for water management.

SUPPORTED BY U.S. Dept. of the Interior, Office of Water Research & Technology

5.0030, AERIAL REMOTE SENSOR DATA COLLECTION PROCESSING AND ANALYSIS FOR ENVIRONMENTAL MONITORING

J.R. DONALDSON, Lockheed Electronics Co. Inc., *Las Vegas, Nevada* 89114 (68-03-2636; J620A-86)

This is one of a multi-part project whose summary may be identical to others.

The purpose of this contract is to provide continuing on-site support for the two major activities of the Remote Sensing Division. Evaluates new and existing concepts for methods of remote sensing measurement. Designs and constructs electrooptical instruments for the remote detection and measurement of specific physical and chemical pollutants. Evaluate and field test remote sensing instruments for specific chemical and physical pollutants. Develop and evaluate automated data systems and applicable software for analysis of test data and analyze test results in terms of meeting design objectives and criteria. Plan and conduct aerial data collection missions including all phases of the mission, except operation of the aircraft. Maintain and calibrate instrumentation and data systems. Provide remote sensing required in oil and hazardous material spill response situations. Develop and verify mathematical models for the analysis of land use and water quality data. Operate and deploy the airborne MSS instrument for the acquisition of digital spectral reflectance measurements of land and water surfaces. Operate and maintain multi-spectral data analysis system (DAS) which is designed to automate the analysis of digital remote sensing data. Develop and operate programs for multi-spectral data analysis. Operate photo-processing facilities to produce final imagery to extract environmentally significant information. Prepare final product reports to include cartography and drafting.

SUPPORTED BY U.S. Environmental Protection Agency, Office of Research & Development, Environmental Monitoring & Support Lab.

5.0031, STUDIES TO IMPROVE WEATHER, WIND TRAJECTORY AND TRANSPORT PREDICTION FOR NUCLEAR TESTS

H.F. MUELLER, U.S. Dept. of Commerce, Weather Serv. Nucl. Supp. Off., *Las Vegas, Nevada* 89114 (SF 54-351)

Provide the continuing meteorological services required in the safety and technical programs associated with all forms of nuclear and non-nuclear experiments conducted by the ERDA Nevada Operations Office at the Nevada Test Site and other places. Studies are conducted to improve the equipment and procedures for measuring, analyzing, and predicting the atmospheric processes involved in the transport of any radioactive effluents from nuclear tests. The potential effects of radioactivity on the bioenvironment justifies continuing efforts to understand transport phenomena and predict the areas to be subject to potential exposure. A variety of approaches are used, including statistical relationships, case studies and dynamical modeling to improve predictions; development of automated telemetered sensors to measure input atmospheric parameters; and development of computer programs to process data, perform calculations, and display results. The meteorological studies are based primarily on weather and wind data collected in the process of supporting nuclear tests, but National Weather Service Network data and local measurements are also used. The effluents from past nuclear rocket engine tests, cratering tests, and atmospheric experiments are used to provide large-scale transport data.

RESULTS: Recent results include (1) the development of additional statistical techniques used as guidance in the prediction of maximum and minimum temperatures, surface wind speeds and directions, and the probability of thunderstorm occurrence, (2) improved mesoscale wind and trajectory prediction models, and (3) the development of techniques for increased automation of data acquisition, processing, and display for operational applications.

SUPPORTED BY U.S. Dept. of Energy, Nevada Operations Office

5.0032, ATMOSPHERIC CLOUD PHYSICS LABORATORY CLOUD FORMING EXPERIMENT FOR THE FIRST (ACPL) MISSION

W.C. KOCMOND, Univ. of Nevada System, Desert Research Institute, *Reno, Nevada* 89507 (NAS 8-32975)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

5.0033, STUDY OF SALT-AFFECTED SALINE SOILS

K.R. CARVER, New Mexico State University, School of Engineering, *Las Cruces, New Mexico* 88003 (NAS 9-15524)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

5.0034, REFINEMENT OF GRID ADJUSTMENT SOFTWARE FOR CONTOUR MAPPING STUDIES
K. GUARD, New Mexico State University, Graduate School, *Las Cruces, New Mexico* 88001 (NAS 6-2885)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

5.0035, BASIC RESEARCH FOR THE EARTH DYNAMICS PROGRAM
I.I. MUELLER, Ohio State University, School of Math. & Phys. Scis., *Columbus, Ohio* 43210 (NSG 5265)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

5.0036, ANALYSIS OF SEVERE STORMS USING DIGITAL RADAR DATA
G.L. HUEBNER, Texas A & M University System, School of Geosciences, *College Station, Texas* 77843 (DF046420; AF-AFOSR-3146-77)

AF function - the Air Weather Service has the responsibility to provide timely and accurate meteorological forecasts to AF operations. Objective - to improve the present structural model of a severe storm under which large hail and tornadoes occur. Contribution - will provide the basic data to improve the AWS forecasting capability to predict severe storms.

New digital radar data from severe storms will be analyzed to determine: 1. The vertical distribution of the liquid-water content, 2. The layer of the atmosphere when the vertical development is taking place, 3. The location where tornadoes appear in the storm and 4. The distribution of large hail. These data provide the data to improve the dynamics and physical models of the storms.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

5.0037, RESEARCH OF MATHEMATICAL MODEL OF AN ORBITING MICROWAVE RADIOMETER
R.W. NEWTON, Texas A & M University System, Graduate School, *College Station, Texas* 77843 (NSG 5266)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

5.0038, INFRARED MAP IN THE VICINITY OF THE CRATER PLATO
R.W. SHORTHILL, Utah Higher Education System, School of Mines & Mineral Ind., *Salt Lake City, Utah* 84112 (NSG 7425)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

5.0039, ASSESSMENT OF FOREIGN RESEARCH AND TECHNOLOGY IN THE MAPPING SCIENCES
A.G. BOBROVSKY, U.S. Army, Theoretical & Appl. Phys. Ctr., *Fort Belvoir, Virginia* 22060 (DA0N8053)

The objective is to monitor, compile, and evaluate technical information. Publish comprehensive reports on foreign research and development advances in specified 'areas of interest' of the MCG community.

Review and assess pertinent government reports, foreign technical publications and patents. Maintain and implement cooperation agreements with other agencies of the government. Evaluations in the areas of foreign image interpretation, holography, gravity, satellite geodesy and geodetic astronomy, photochemistry, and instrumentation will be made. Reports will be published semi-annually in each of the above areas.

SUPPORTED BY U.S. Dept. of Defense, Office Chief of Engineers, Corps of Engineers

LIFE SCIENCES

Includes Life Sciences (general); Aerospace Medicine; Behavioral Sciences; Man/system Technology and Life Support; and Planetary Biology.

6.0001, SIMULATOR RUNWAY TOUCHDOWN ZONE VISUAL REQUIREMENTS, TEXTURAL VISUAL CUE CONSIDERATIONS (TD-ZONE)
G.H. BUCKLAND, U.S. Air Force, Human Resources Laboratory, *Chandler, Arizona* 85224 (DF223200)

To assess the effects of visual scene textural information cues upon experienced pilot flare and touchdown performance in flight simulators.

Ten experienced T-37 instructor pilots will fly straight-in approaches and touchdowns in the ASPT using six different runway visual scenes and two motion conditions. The runways will differ in terms of the textural cues provided in the runway touchdown zone area, ranging from a runway representing the minimum amount of visual information to the standard ASPT runway with superimposed grids providing textural cues. The grids will have variable spacing of the lines in order to provide visual cues which can be readily specified. One night visual landing scene comparable to the VITAL III will also be used in order to compare day and night scene pilot performance in terms of VITAL III technology. The different runways will also be tested under conditions of 6 DOP motion and no motion, in order to evaluate the contribution of platform motion to pilot performance, with special attention to the motion feedback cue at aircraft touchdown.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Human Resources Lab.

6.0002, ASUPT NIGHT SCENE EVALUATION
D.F. CATANEO, U.S. Air Force, Human Resources Laboratory, *Chandler, Arizona* 85224 (DF222070)

To evaluate the extent to which simulator training using as ASUPT reduced field of view night scene transfers to T-37 aircraft day time training.

A data base on trials to proficiency in T-37 aircraft training on selected maneuvers has been developed in work unit 1123-01-14 under conditions of no ASUPT training and using the full ASUPT day visual scene. The proposed project will extend these data by providing training on selected maneuvers using the ASUPT night scene with a reduced field of view. A sample of UPT trainees will be trained using the same syllabus developed for the earlier study but restricting the ASUPT visual to a night scene and to a 28 degrees x 44 degrees FOV. Trials to criteria on each maneuver will be recorded in the aircraft and these data compared to those compiled in the earlier study.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Human Resources Lab.

6.0003, KC-135 WST VISUAL SYSTEM EVALUATION
J.A. THORPE, U.S. Air Force, Human Resources Laboratory, *Chandler, Arizona* 85224 (DF223460)

To compare the training effectiveness of the three types of flight simulator visual systems (day/night color computer generated image (CGI), night only/point light source CGI, and TV-model board) for use in KC-135 combat crew training school (CCTS). The results of this comparison will impact the decision to procure a visual system for three CCTS simulators. This investigation will (1) study in depth the role of a visual system for tanker-transport-bomber (TTB) flight simulators, (2) determine instructional strategies best suited for such a device, and (3) develop innovative techniques to maximize training in the CCTS.

Three groups of ten KC-135 student copilots from CCTS will receive specialized training in simulators equipped with one of the three visual systems of interest. Following simulator training, each copilot will fly the aircraft and transfer of training will be as-

sessed. Student copilots will be used instead of pilots upgrading to the aircraft commander crew position since it is expected that the less experienced student copilot will show the most learning during simulator training. The task to be trained will be the visual flight rules (VFR) traffic pattern because it is the most visually dependent task flown in the KC-135. Therefore, it is the task which exercises the visual system to the greatest degree. The utility of a side window as well as a forward window will be assessed by training all students to fly left hand traffic patterns from the left seat. This restriction for left seat training exists because of hardware availability; the TV-model board system, as it is currently configured, can only display a side field of view from the left seat. Therefore, all three simulators will be configured for left window-left seat student training for standardization.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Human Resources Lab.

6.0004, HORMONE PURIFICATION BY ISOELECTRIC FOCUSING IN SPACE
M. BIER, Univ. of Arizona, School of Agriculture, *Tucson, Arizona* 85721 (NAS 8-32950)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

6.0005, TOXIC HAZARDS RESEARCH ENVIRONMENTAL TOXICOLOGY
T.T. CROCKER, Univ. of California, School of Medicine, *Irvine, California* 92664 (DF319590; F33615-76-C-5005)

This program will provide specific data and knowledge on the toxic properties of new materials, propellants, and other atmospheric contaminants used or encountered by Air Force personnel in the development, test, and operational phases of new aeronautical, aerospace, missile, and orbital systems. The results of this program, in conjunction with the overall toxicology program, will provide the Air Force and other governmental agencies with tolerance criteria to provide for the optimum protection of Air Force and other Department of Defense personnel. Pertinent toxicological information will provide guidance to design engineers in order to develop aeronautical, aerospace vehicles, and launch systems with maximum functional capability. Results will also be used for the development of design criteria for pollution abatement procedures and equipment.

The contractor shall maintain and operate the toxic hazards research unit and conduct toxicological research on a wide variety of current and advanced USAF research and development materials. Emphasis is upon the applied inhalation research area. The spectrum of occupational inhalation exposures that will be investigated begins with accidental, short-term, high-level exposures, includes occupational daily, 8-hour, industrial exposure, and culminates in truly uninterrupted, long-term continuous exposure as experienced during confinement in sealed habitable atmospheres. In addition, the effort shall provide definitive data concerning the environmental impact of selected Air Force materials through the use of representative aquatic and plant species. This R&D effort to develop environmental pollution toxicity criteria for Air Force chemicals is a firm AFSC requirement as outlined in AFR 19-1 and AFR 19-2.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aerospace Medical Research Labs.

6.0006, REGULATION OF ADRENAL GLUCOCORTICOID RESPONSE TO HEMORRHAGE IN THE CONSCIOUS DOG
M.F. DALLMAN, Univ. of California, School of Medicine, *San Francisco, California* 94122 (NCA 2-665806)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

6.0007, CONTROL OF BLOOD VOLUME
D.J. RAMSAY, Univ. of California, School of Medicine, *San Francisco, California* 94122 (NCA 2-665807)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

6.0008, PERFORMANCE MEASUREMENT SYSTEM FOR C-5 AIRCREW MEMBERS
J.R. SWINK, Logicon Incorporated, *San Pedro, California* (DF222780; F33615-76-C-0056)

To define the requirements for a reliable, valid, objective/quantitative performance measurement system for the members of the C-5 aircrew (pilot, co-pilot, navigator, flight engineer and loadmaster).

The contract research program will consist of a three-phase effort. In phase I C-5 aircrew tasks and performances essential to effective system operation in characteristic or representative military airlift command (MAC) missions will be defined and their potential for use in a performance measurement system evaluated. During phase II the capabilities of current and projected new C-5 simulators for providing quantitative measurements of aircrew performance on essential mission operational tasks will be assessed and means for augmenting current simulators for performance measurement purposes will be identified. In phase III the results of phases I and II will be synthesized to describe the requirements for a C-5 aircrew performance measurement system for use in guiding the subsequent development and implementation of the required system.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Human Resources Lab.

6.0009, A COMPREHENSIVE ANALYSIS OF HUMAN PERFORMANCE REQUIREMENTS FOR FUTURE SPACE FLIGHT
F. AKINS, Univ. of Santa Clara, Graduate School, *Santa Clara, California* 95053 (NCA 2-685805)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

6.0010, CHARACTERIZATION OF LOW-INTENSITY X-RAY IMAGING DEVICES
G.A. FERGUSON, Howard University, School of Engineering, *Washington, District of Columbia* 20001 (NSG 5268)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

6.0011, QUANTITATIVE DETERMINATION OF UV-INDUCED DEOXYRIBONUCLEIC ACID DAMAGE AND REPAIR IN HIGHER PLANTS
G.P. HOWLAND, State University of Fla. Sys., Graduate School, *Gainesville, Florida* 32601 (NAS 9-15529)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

6.0012, HUMAN PERFORMANCE MEASUREMENT IN AIR SYSTEMS
D.A. NORMAN, U.S. Navy, Human Factors Laboratory, *Orlando, Florida* 32813 (DN221040)

To improve control of the training process and of computer-based training systems in particular through development, test and evaluation of a comprehensive subsystem for the measurement of human performance. The availability of precise and relevant assessment structures can increase training effectiveness by giving a true picture of skill acquisition level at any point in the training process.

Identify appropriate training settings; select a class of desired trainee behaviors for exhaustive analysis; define and implement a measurement structure based on a measurement subsystem of adequate complexity; conduct empirical tests to evaluate techniques for discriminating among candidate members of a

measurements pool; investigate the utility of highly refined measurement subsystems in training process control, e.g., ability to predict the trainee's readiness to transfer.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Training Equipment Center

6.0013, A MODEL SYSTEM FOR STUDIES ON LIVER METABOLISM IN SPACE
M.E. TOLBERT, State University of Fla. Sys., Graduate School, *Tallahassee, Florida* 32307 (NSG 2311)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

6.0014, PARTICIPATION OF TRANSFER RNA IN THE ORIGIN OF PROTEIN BIOSYNTHESIS
A. RICH, Mass. Inst. of Technology, School of Science, *Cambridge, Massachusetts* 02139 (NCA 2-425801)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

6.0015, HIGHER ORDER LANGUAGES FOR FLIGHT SIMULATOR PROGRAMS
J. GOODENOUGH, Softech Incorporated, *Waltham, Massachusetts* 02154 (DF228150; F33615-77-C-0029)

To investigate the problems and approaches to developing a higher order language (HOL) for standard use in future Air Force simulators. The work will result in a thorough programming analysis of flight simulation problems and use of this analysis to develop and evaluate alternative programming approaches. This will give the Air Force the technology necessary to increase the efficiency of its programming in future simulations.

A technique will be developed that can be used to analyze large-scale programming problems to determine what programming and information processing features are required. This technique will then be applied to perform a detailed analysis of the programming of modern flight training simulators. Specifications for an ideal simulation higher order language will be developed, and existing higher order languages will be evaluated. Modifications required to make the most suitable existing languages of maximum use in simulation will be determined. Alternative approaches to implementing a standard HOL will be identified and evaluated.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Human Resources Lab.

6.0016, RESPIRATORY PARAMETERS IN BREATHING SYSTEM DESIGN
B. BISHOP, State University of New York, School of Medicine, *Buffalo, New York* 14214 (DF318310; F41609-75-C-0003)

Aircrew members may be required to use oxygen equipment for extended periods under physiologically stressful conditions. With present pressure-demand oxygen systems the user begins to experience decreased oxygenation during ascents beyond 34,000 feet, and measurable hypoxia as he exceeds 40,000 feet. Positive pressure breathing delays these effects and provides emergency descent protection from altitudes as high as 50,000 feet. In other operational situations negative pressure breathing may occur as a result of flow resistance imposed by long distances between regulator and mask such as in special C-130 operations, leaflet operations, and planned emergency oxygen systems of AABNCP and AWACS. Breathing resistance of the hose/tubing arrangement in the T-38 has been a suspected cause of physiologic incidents. Rebreather type systems, pressure suit helmets, and closed-loop oxygen generation systems may impose abnormal oxygen and carbon dioxide concentrations. The purpose of this effort is to investigate the respiratory stresses encountered during positive and negative pressure breathing in combination with mild hypoxia or slightly elevated carbon dioxide concentration and to attempt to define the relative degree of respiratory stress imposed by each when they occur in combination. The combined effects of positive or negative pressure breathing with mild hypoxia and/or mild hypercarbia have not previously been studied. Data obtained from this study will augment the core biotechnology base, provide information for sizing of oxygen systems, and serve as a basis for establishing criteria of maximum acceptable positive pressure and negative pressure in combination with mild hypoxia or slightly elevated carbon dioxide concentrations. These data will be applicable to development of future breathing systems as well as for reevaluation of systems in current use.

Human volunteer subjects will be exposed to various low levels of positive or negative pressure breathing while inspiring mildly hypoxic or hypercarbic gas mixtures. The compensatory responses of the respiratory system will be examined and analyzed to determine the degree of physiologic stress imposed by these ventilatory stimuli singly and in combination, and the relative effect of each when imposed in combination. Data will include but not be limited to effects on tidal volume, frequency of breathing, (Text Truncated - Exceeds Capacity)

SUPPORTED BY U.S. Dept. of Defense, Air Force, School of Aerospace Medicine

6.0017, STATIC TUBE ZERO G ELECTROPHORESIS OF HUMAN PANCREATIC ISLETS OF LANGERHANS CELLS
C.J. VANOSS, State University of New York, School of Medicine, *Buffalo, New York* 14214 (NAS 8-32947)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

6.0018, VERIFICATION AND REFINEMENT OF PARAMETERS OF HUMAN OPERATOR MODELS FOR PILOT TRAINING MEASUREMENTS
N. CHAO, City University of New York, Undergraduate School, *Flushing, New York* 11360 (DF048910; AF-AFOSR-3350-77)

AF function - pilot training effectiveness measures are a necessary aspect of assessing the effectiveness of pilot training programs. Deficiency - improved models of pilot performance are needed to obtain more useful parameters for pilot training measurement. Objective - this work effort is designed to modify and improve an operator model that may improve current measures of pilot training performance. How research contributes - verification of an improved operator model will enhance the goal of establishing pilot training effectiveness measurement criteria throughout the entire course of pilot training.

The results will assess the promise of a new time domain model for determining pilot training as compared to existing models. The range or trend of various parameters as a function of pilot skill or training will be determined. The main feature of the new time domain model is the averaging aspect of the human operator, where an output value is not simply based upon a single value input delayed by some time.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

6.0019, IDENTIFICATION OF FINITE STATE MODELS OF A HUMAN OPERATOR
R.A. MILLER, Ohio State University, School of Engineering, *Columbus, Ohio* 43212 (DF046260; AF-AFOSR-3152-77)

AF function - Air Force operations involve a multitude of control related information processing and decision-making tasks which are performed by aircrew personnel. Deficiency - optimization of these processes is needed. Analytical methods currently available are inadequate. Objective - this research is a control theoretic study of a human operator performing a sequential decision-making task in which only a finite number of alternatives are available at each stage. Results will improve the ability to model and analyze one member of systems-discrete manual control systems. How research contributes - the research should produce a valuable tool for the analyses of certain types of supervisory decisions in hierarchical manual systems. The decision models can be combined with other equipment models and other manual control models to predict system performance in various environments.

The approach will be development of formal parameterized structure of appropriate finite-state models and efficient estimation algorithms. These will be tested on data produced by man-in-the-loop simulation.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

6.0020, CARDIOVASCULAR, RENAL & RESPIRATORY EFFECTS OF HIGH-INTENSITY, INTERMEDIATE-DURATION, LOW-FREQUENCY VIBRATION

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AF function - Air Force operational personnel are subjected to a number of environmental stresses, one of which is vibration. With increasing numbers of missions in high-performance aircraft at low altitudes, crew members will be exposed to increased quantities and durations of low-frequency vibrations. Deficiency - the circulatory system is one of the mammalian systems most affected by vibration - of particular interest is the influence of vibration on the transport of certain blood elements to and across the vessel walls and the effects on renal function. For example, if cholesterol transport to the arterial wall is enhanced and/or if renal function is impaired this would have significant implications on long-term health problems of exposed personnel. Objective - this effort will investigate the interaction between the physiological and fluid mechanical phenomena associated with whole body sinusoidal vibrations. How research contributes - this research supports objectives identified in AFSC RO 1.6, 'aircrew safety and effectiveness in mechanical force environments' and RO 1.7, 'aerospace medicine'.

Vibration studies will be continued and expanded to include investigations into permeability and wall history. In addition, studies will include pulsed ultrasonic Doppler measurements of aortic velocity in animals undergoing chronic vibration in an effort to couple any changes in hemodynamics with changes in wall permeability and observations of lipid deposition pattern.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

6.0021, ADVANCED COMPONENT TECHNOLOGY

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This work unit will develop operator-centered display technology for AF real-time reconnaissance and weapon delivery functions. Display concepts will be formulated and prototype equipment developed to enhance man's visual ability to interface with various state-of-the-art and advanced development reconnaissance weapon delivery, teleoperator and simulation subsystems. These concepts involve visually-coupled control/display devices (helmet-mounted sight/display), virtual image display techniques and holographic lens projection techniques. Consultation will be provided for further design, development, and deployment of systems based on these concepts. Efforts are coordinated with tri-service display technology panel members, the Naval Air Systems Command, Naval Air Development Center, Army Night Vision Laboratory, Air Force Armament Laboratory, Aeronautical Systems Division, and the Air Force Office of Scientific Research. This effort supports AFSC development goals, TC-2, TC-4, TC-5, TC-7, and MS-4, PMDR P2033(5)/64708f/5973, visual coupling aids, and TAC R-C 313-74, slewable electrooptical reconnaissance sensor.

Promising state-of-the-art technology in optics, electrooptics and electronics will be applied to develop and evolve operator display subsystems and concepts which enhance overall operator performance in target acquisition and weapon delivery tasks. During FY 77, design criteria and specifications will be defined for the interim and advanced helmet display components for the visually-coupled airborne systems simulator (VCASS). Solid-state matrix-element image sensing and generating devices will be integrated with new techniques, including holographic diffraction optics, to project images to the operator's visual field. Development of variable resolution and color virtual image displays will be continued. Pseudo-stereo effects and image multiplexing will be demonstrated and their effects on target acquisition defined in the display/image metric laboratory. Variable transmission visor techniques will be addressed. Display techniques for multisensor information (forward-looking infrared, low light level TV, radar and laser sensors) will be evolved. This work unit, in part, encompasses work previously reported under work unit 7184-04-42, display concept development.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aerospace Medical Research Labs.

6.0022, EFFECTS OF AF PROPELLANTS AND CHEMICALS ON METABOLIC MECHANISMS

M.E. GEORGE, U.S. Air Force, Aerospace Medical Res. Lab., *Dayton, Ohio* 45433 (DF320700)

The purpose of this basic research is to identify and define those underlying physiological and biochemical mechanisms associated with the systemic toxicity of chemicals and material.

Studies on the effects of toxic, carcinogenic and mutagenic chemicals of special Air Force interest and application on metabolic pathways and mechanisms of action require use of radioactive tracers, gas and liquid chromatography coupled with mass spectrometry, and electron microscopic evaluation of cellular and subcellular changes. The ultimate application of these fundamental mechanisms is to facilitate extrapolation of animal data to humans by selecting the most appropriate laboratory animal species which handles the compound similar to the metabolic pathways of man.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aerospace Medical Research Labs.

6.0023, DEVELOPMENT OF DESIGN CRITERIA FOR RAPID PRE-EJECTION CREW RESTRAINT

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Injuries resulting from exposure to aerodynamic forces during emergency escape using open ejection seats are a major problem. The solution requires both ejection seat stability and limb restraint and both are interrelated, i.e., the lack of one will aggravate the other. The restraint system must provide complete protection during escape but not encumber the crewmen during normal flight and thus compromise the mission. Furthermore, in multiplace aircraft restraint must be quickly and automatically applied on pilot command to properly preposition and protect crewmen who are not prepared to eject. The objective of this research is to define design criteria for mechanisms which will automatically position and restrain crewmen in an optimum body posture for safe emergency escape. The criteria will include minimum actuation times, maximum retraction forces and velocities, and body segment restraint sequencing timing.

Experiments will be conducted using a special test fixture consisting of an ejection seat mockup and a system of hydraulically actuated devices which can independently or sequentially retract shoulder straps, lap belt arm restraint, and leg restraint. Volunteer subjects will be automatically restrained utilizing varying initial body positions and retraction speeds. Retraction force-time histories, impact forces and body segment accelerations and trajectories will be measured during each test. Data collected during these tests will be studied using a mathematical model of the human body, the restraint system, and the retraction device. The mathematical analysis will permit a parametric analysis of the restraint system design criteria and prediction of injury modes as well as performance of the protection system under adverse flight conditions. The resulting design criteria and analysis will be provided to the Aeronautical Systems Division for incorporation into system development specifications and the AFSC Design Handbook series.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aerospace Medical Research Labs.

6.0024, CONDUCT AIR AND GROUND CREW NOISE STUDIES TO EXPAND/UPDATE USAF BIOENVIRONMENTAL NOISE DATA HANDBOOK

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USAF aircraft and equipment operations generally produce adverse noise levels at flight crew, passenger, and ground crew locations which must be evaluated with respect to hearing risk, ear protection requirements, voice communication capabilities, facility siting problems, etc. The objective of this work unit is to expand and update the USAF bioenvironmental Noise Data Handbook (developed under work unit 72310418) and, thereby, provide the data necessary to define these physical noise environments for use by majcom/airbase bioenvironmental engineers, flight/ground safety officers, and others concerned about personnel safety and effectiveness.

The technical approach is to conduct field measurements, perform spectral analyses, and then apply Noisebank, the most advanced Omega software, and AFR 161-35 exposure limits to compute the required physical and psychoacoustic measures.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aerospace Medical Research Labs.

6.0025, PERFORMANCE MODEL OF SUSTAINED G EFFECTS ON AIR COMBAT EFFECTIVENESS

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Primary objectives are: (a) to obtain data on human operator performance during and following exposure to sustained high g stress, (b) to measure associated physiological parameters, and (c) to formulate a model of human operator performance under sustained acceleration. These objectives are part of an ongoing USAF effort to examine air-to-air combat tracking scenarios and mathematically describe the pilot in order to improve fighter tactics and aircraft design (TAC Avenger).

Human subjects will be exposed to standard sustained high g profiles on the AMRL Dynamic Environment Simulator and tracking errors recorded for use in model development performance, and stress-related physiological measures will also be made to determine mechanisms underlying performance decrements observed during acceleration stress.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aerospace Medical Research Labs.

6.0026, MEASUREMENT OF WHOLE BODY INERTIAL AND KINEMATIC RESPONSE

J.P. KILIAN, U.S. Air Force, Aerospace Medical Res. Lab., *Dayton, Ohio* 45433 (DF322740)

The mechanical and dynamic properties of aircrew members are not sufficiently defined to allow an adequate determination of the effect a crew member, seat occupant, may have on the overall performance of an escape system. For example, the designer is unable to determine the effectiveness of ejection seat trajectory divergence techniques required to avoid collisions during escape from multiplace aircraft such as the B-1, TF-15, and F-16B. Aeromedical data that are required include human body center-of-gravity, moments of inertia, aerodynamic properties and dynamic inertial response characteristics. The objective of this effort is to measure the inertial response of the human body under short-duration acceleration conditions such as those experienced during emergency escape.

Impact tests will be accomplished using volunteer human subjects and special anthropomorphic dummies. Inertial and kinematic responses will be measured using accelerometer, force cell and photometric techniques. Initial testing will be done in the sideward direction (gx) using varied levels of body support and restraint. Phase II of the effort will concentrate on the measurement of whole body and body segment responses in the plus gx direction. Final phases will focus on combined plus gz and minus gx acceleration profiles. Data will be incorporated into a mathematical model which will predict the dynamic response of the total human body under any acceleration condition generated during emergency escape. Statis inertial properties of the human body determined under another work unit will also be incorporated into the model to provide a more comprehensive understanding of initial body position and anthropometric variations within the flying population. The technology will be provided to the Air Force Flight Dynamics Laboratory and the aerospace industry for use with multidegree-of-freedom escape system computer models.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aerospace Medical Research Labs.

6.0027, HUMAN PHYSICAL CAPABILITIES FOR AF JOBS

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To improve the data base for describing the mobility, strength, and endurance variability of AF men and women where existing data are inadequate for the design, operation, and maintenance of AF systems. To improve systems effectiveness by developing designs for controls comparable with the operator's capabilities. To assess the adequacy of female strength and endurance characteristics for assignment to the role of aircrew members. To improve the design and placement of aircraft controls to minimize performance degradation from acceleration.

Methods are being employed to measure static strength and body mobility characteristics (FY 77-78). New methods for measuring dynamic strength and endurance are being investigated in FY 78-80. Equipment and procedures are being developed to measure and record the human operator configuration while performing aircrew-related tasks. To provide control design recommendations directly to procuring activities or through technical reports or design standards to improve the efficiency and operability of AF systems. Design complex controls based on the biomechanical characteristics of the hand to reduce the incompatibility between the precise operation of a control and its secondary control. Activation of controls in conventional and high-acceleration cockpits is being investigated. The effects of encumbering and restrictive equipment and clothing on operator performance is being investigated. A methodology will be developed in FY 77 for use by AFFTC to evaluate flight control resistance characteristics of new systems.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aerospace Medical Research Labs.

6.0028, USE OF THE C-5 AIRCRAFT GROUND PROCESSING SYSTEM FOR PROTOTYPING ADVANCED MAINTENANCE SYSTEMS APPLICATIONS (AMS TEST PROGRAM)

E.G. MCFALL, U.S. Air Force, Human Resources Laboratory, *Dayton, Ohio* 45433 (DF228320)

To modify the ground processing system (GPS), an advanced maintenance management system unique to C-5 aircraft, to incorporate twenty two new maintenance management concepts, primarily in automation/distribution of existing maintenance forms and automated parts ordering. The changes will be incorporated incrementally into the GPS. An evaluation will be performed to determine the effectiveness of these changes in reducing administrative workloads, increasing visibility of management information and increasing overall operational effectiveness. Additionally, the modified system will be compared against a non-GPS maintenance system to enable evaluation for Air Force-wide application. The specific objective of AFHRL's participation is to evaluate these concepts from a human factors standpoint (e.g., ease of use, confidence in system, training requirements) and to provide consultation in the design and execution of the overall evaluation.

New concepts will be implemented incrementally into the basic GPS and evaluated on the basis of operational impact and human factors. AFHRL will concentrate on the human factors investigation, to be accomplished by: (1) assisting in task analysis, (2) identifying human factors evaluation areas, (3) developing job tests and data collection forms, (4) monitoring data collection, (5) analyzing human factors data, and (6) reporting findings. Manpower engineering teams will be the primary data collectors for both the human factors data, and the operational system evaluation data. To insure a valid assessment of change impact (resulting from automation), to be projected for other GPS and non-GPS applications, it is necessary to measure the same tasks in a similar but non-GPS system. The McGuire AFB, C-141 maintenance organization has been selected for this purpose. This effort will begin in February 1977 with evaluation of present system. Analysis and development of the proposed system will be accomplished as implemented by MAC. Total evaluation

will be completed by January 1980. More detailed milestones can not be specified at this time. They will be specified as the effort progresses.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Human Resources Lab.

6.0029, CONTROL-DISPLAY INTEGRATION AND EVALUATION
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The purpose of this work unit will be to develop new control, display, and feedback hardware and software concepts that utilize hand, head, eye, and other human response modes as controllers to improve the piloting, weapon delivery, and reconnaissance sensor control of manned and unmanned aircraft. This work unit supports AFSC development goal TC-2.

The basic approach will be to collect man-machine system performance data on laboratory simulation, breadboard, and/or prototype equipment designed to make efficient use of the human's natural perceptual and response capabilities. The final product will be new equipment concepts and designs that have been developed from and validated by man-machine system performance data. The following control-display hardware concept work is planned: (1) eye and head controlled switching, (2) tracking situation display, (3) multi-resolution eye aimed television, (4) helmet-mounted oculometer, (5) voice controller, (6) eye controlled sensor zoom, and (7) target trajectory and operator response predictor displays. In addition, pilot studies will be conducted on new concepts for the display of control information, the use of non-utilized human response modes to control equipment, and techniques to modify the human's response signals to obtain more optimum control. A basic tool to be utilized in this work will be the use of digital computers as follows: (1) to process the environmentally sensed information before it reaches the display, (2) to filter and modify the human's response signals before they reach the controlled element, and (3) to process and modify feedback information about the controlled element before it is returned to the display. This effort was previously reported under work unit 7184-04-43, control concept development.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aerospace Medical Research Labs.

6.0030, EFFECTS OF LONG-DURATION NOISE EXPOSURE ON HUMAN AUDITORY PROCESSES
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Noise exposure standards for durations of 16 hours and greater as experienced during long missions and duty assignments are tentative and require additional knowledge to finalize criteria. Research carried out under this work unit shall attempt to identify and measure changes in human auditory processes effected by noise exposure durations of greater than 16 hours. These efforts will provide part of data base necessary to validate and/or revise existing tentative hearing damage risk criteria and establish firm criteria and standards. This work is being coordinated with the Environmental Protection Agency, and is being partially funded by EPA under interagency agreement number EPA-IAG-D6-0356.

The approach will be to measure safe temporary hearing losses induced in human subjects by long-duration low-level acoustic exposures and to analyze the hearing recovery curves as additional indicators of risk. Human subjects will be exposed to broadband noise with exposure durations of between 24 and 48 hours. Groups of subjects will experience systematic variations of such acoustic parameters as the intensity, duration, and duty cycle of the test stimulus. Effects of the stimuli will be identified by monitoring the subjects' audiometric thresholds at specific time intervals.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aerospace Medical Research Labs.

6.0031, EVALUATION OF BIODYNAMIC RESPONSE TO ESCAPE SYSTEM AND AIRCRAFT CRASH ENVIRONMENT
P.A. GRAF, Univ. of Dayton, Res. Inst., *Dayton, Ohio* 45409 (DF320280; F33615-76-C-0525)

The objectives are (1) to provide an efficient means for processing impact data collected on the various AMRL impact facilities as well as data collected by other governmental agencies for analysis by the AMRL, (2) to provide statistical analysis capability to support the design of impact experiments, (3) to provide a continuous error analysis program with respect to data collection and processing methods and (4) to provide data in finished form to ultimately be used by AMRL investigators to establish system design criteria or to evaluate the effectiveness of existing systems.

Data handled under this program will be processed and analyzed using conventional techniques. New methods or modifications of existing techniques may be developed and recommended by the contractor to meet specific program requirements.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aerospace Medical Research Labs.

6.0032, HEAD IMPACT CRITERIA
N.S. PHILLIPS, Univ. of Dayton, School of Engineering, *Dayton, Ohio* 45409 (DF320650; F33615-77-C-0534)

Objectives are: (1) provide methods to assess biomedical effects of direct impact of crewman's helmeted head, (2) determine the influence of the usaf flight helmet on impact transmitted to head, (3) determine head impact measuring techniques and (4) develop method to simulate the crewman during bird impact tests of aircraft canopies. The ultimate goal is impact test and evaluation criteria for new aircraft windshields/canopies and flight helmets.

Canopy impact data from tests of F-16 and F-111 canopies will be analyzed, existing analytical models of aircraft canopy impact responses will be applied, the importance of crew position during impact will be evaluated. Analogs of the crewman's impact response and helmet dynamics will be used to assess canopy impact environments and they will be refined for aircraft canopy design evaluation applications, and impact tests of helmets will be done to determine their protection properties. Standards for aircraft canopy test and evaluation criteria will be developed.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aerospace Medical Research Labs.

6.0033, VESTIBULAR RECEPTORS IN SPACE
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SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

6.0034, CATECHOLAMINE CONCENTRATION OF BODY FLUIDS
UNKNOWN, Univ. of Texas, Graduate School, *Galveston, Texas* 77550 (NAS 9-15565)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

6.0035, APPLICATION OF LASER RANGING AND VERY LONG BASE INTERFEROMETRY DATA TO A STUDY OF PLATE TECTONIC DRIVING FORCES
H.B. HARTMAN, Texas Tech University, Graduate School, *Lubbock, Texas* 79409 (NSG 7435)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

6.0036, MULTIPLE RISK FUNCTIONS FOR AIR FORCE PERSONNEL
R.A. ALBANESE, U.S. Air Force, School of Aerospace Med., *San Antonio, Texas* 78235 (DF321780)

Coronary artery disease (CAD) is a major cause of ineffective time and disability retirement in the Air Force, and has been implicated in aircraft accidents. Thus early diagnosis and prevention of CAD in aircrew members is of importance to the Air Force. Several clinical factors (serum cholesterol levels, blood pressure, EKG changes, etc.) are known to be associated with an increased risk of CAD in human subjects. This work unit focuses on the development of mathematical equations which numerically relate clinical risk factors to the occurrence of CAD in flying personnel such that these equations can actually be used in early disease diagnosis and prevention at significant costs savings to the Air Force.

The first step will be a computer implementation of the Walker-Duncan algorithm for fitting the multiple logistic risk function. This function, when properly fitted to Air Force data, will numerically indicate the presence of CAD and/or the potential to develop CAD in flying personnel as a function of available clinical risk factors. The Walker-Duncan algorithm must then be compared with discriminant analysis techniques for fitting the multiple logistic risk function. The clinical factors entering the risk function as predictors of disease will be freed of confounding side-conditions, including seasonal effects, and daily rhythms, using multivariate statistical techniques. To refine the diagnosis of CAD, statistical analyses of X-ray views of the heart vessels (coronary cineangiograms) will be accomplished to improve the delineation of disease severity. This work was formerly a part of project 6319 and was documented under work unit 02-10.

SUPPORTED BY U.S. Dept. of Defense, Air Force, School of Aerospace Medicine

6.0037, NUCLEAR SURVIVABILITY OF AIRCREW - HIGH DOSE EXPOSURES

D.J. BARNES, U.S. Air Force, School of Aerospace Med., *San Antonio, Texas* 78235 (DF321570)

The objectives of this project are to gain data to be used as relevant input parameters to models designed to predict the effects of irradiation upon human performance. Utilizing primates trained to perform tasks analogous to those accomplished by human operators of the B-1, radiation effects on performance can be determined and subsequently extrapolated to gain probabilities of mission success.

This work unit is the first phase of a two-part experimental procedure to examine 'worst case' and 'probable' environments expected to be encountered by aircrew personnel in the event of thermonuclear warfare. Six trained primates performing simultaneously on each of two tasks will be irradiated and pre- and post-irradiation performance measures taken. The decrement recorded in tracking, discrete avoidance, and reaction-time data will be utilized as input data to modeling efforts by USAFSAM and other DoD agencies.

SUPPORTED BY U.S. Dept. of Defense, Air Force, School of Aerospace Medicine

6.0038, NUCLEAR SURVIVABILITY OF AIRCREW - LOW DOSE EXPOSURES

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The objectives of this project are to gain data to be used as relevant input parameters to models designed to predict the effects of irradiation upon human performance. Utilizing primates trained to perform tasks analogous to those accomplished by human operators of the B-1, radiation effects on performance can be determined and subsequently extrapolated to gain probabilities of mission success.

This work unit is the second phase of a 2-part experimental procedure designed to determine the most probable effects of ionizing radiation upon aircrew performance. Six trained primates performing simultaneously on each of two tasks will be irradiated and pre- and post-irradiation performance measures taken. The decrement recorded in tracking, discrete avoidance, and reaction-time data will be utilized as input data to modeling efforts by USAFSAM and other DoD agencies.

SUPPORTED BY U.S. Dept. of Defense, Air Force, School of Aerospace Medicine

6.0039, EFFECTS OF WEAPONS RADIATION ON AIRCREW TASK PERFORMANCE

G.C. BROWN, U.S. Air Force, School of Aerospace Med., *San Antonio, Texas* 78235 (DF315770)

The development of mathematical models of crew survivability/vulnerability analysis is dependent upon accurate descriptions of performance effectiveness under radiation environmental conditions. Studies of high dose, high dose-rate exposures have largely been completed. Emphasis will be placed on lower dose and dose rates, specific long mission scenarios and complex interactions of ionizing and non-ionizing radiation with task requirements. The objective of this effort is constructed dose-response curves for radiation environments and interactions of interest to SAC. Specifically, the combined effects of multiple radiation pulses, sustained low dose rate exposure and aircrew task complexity upon system performance effectiveness will be determined. The description of aircrew performance during and following irradiation, for the purpose of S/V model applications (7757-05-23), is the goal of the effort.

Selected models of operational task requirements will be utilized. Highly accurate simulations of specific system dynamics will be constructed and analyzed through application of mathematical control theory. Closed loop studies of operator control capabilities in radiation environments will be assessed through the identification, description, construction and utilization of continuous (tracking) tasks. An elaboration of the problems of motivation, fatigue, work load and time stress will be undertaken to further strengthen S/V model predictions.

SUPPORTED BY U.S. Dept. of Defense, Air Force, School of Aerospace Medicine

6.0040, BIOMEDICAL EVALUATION OF QUALITY CRITERIA FOR BREATHING GASES AND CABIN ATMOSPHERES

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The advances and requirements in present and future aircraft require the development of new and novel oxygen systems, including the development of on-board oxygen generation systems. It is the purpose of this effort to review current breathing gas specifications for adequacy and to project these specifications, based on physiologic criteria, into the standards for the quality of breathing gases derived from a comprehensive list of oxygen sources, including liquid and gaseous oxygen, chlorate candle, mole sieve, electro-chemical or other existing or yet-to-be-developed generator systems for emergency oxygen systems. In addition, the biomedical data base on which the standards for oxygen quality are derived will be used for establishing emergency use standards for permitting interim emergency waivers of standards when operationally justified. Previous accomplishments in this area are documented under work unit 7164-17-01. This work unit is being established to implement a new technology planning objective as directed by Headquarters, Aerospace Medical Division.

A systematic review of the historical physicochemical and biomedical data on which breathing oxygen specifications are based will be performed. This will include an analysis of the modes by which contaminants gain entry into breathing oxygen, and the potential contaminant levels associated with each of these modes. Specifications for all types of oxygen sources, e.g., liquid, gaseous, chlorate candles, etc., will be analyzed. From this review a comprehensive data bank of operational and biomedical aspects of specifications developed will be compiled. This data bank will be used to reevaluate current specifications through retrospection and make recommendations for modifications or for the development of new specifications for emergency oxygen systems. A continuing consultative effort will be performed for the San Antonio ALC/Directorate of Energy Management and the 412A Life Support SPO.

SUPPORTED BY U.S. Dept. of Defense, Air Force, School of Aerospace Medicine

6.0041, DEVELOPMENT OF AN ADVANCED DESIGN ANTI-G SUIT

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Develop anti-g suit design concepts to be used in the research and development of advanced anti-g suits. Experimental anti-g suits will be developed to determine advanced suit design which will offer improved g-protection. Anti-g suit design specifications will result from this effort which will terminate with a technology transfer to ASD/AEL.

Various anti-g suit design concepts will be evaluated on the SAM and NADC centrifuges with physiologic criteria of g-protection using experimental subjects. Design concepts to be considered include: bladder sizes, capstans, inflation profiles, and the use of anti-exposure garments. The anti-g suit design which offers the greatest g-protection with subject comfort will be integrated with the advanced anti-g valve (WU 7930-12-06) for the fabrication of an advanced g-suit/valve system (WU 7930-12-xx). Specifications of this advanced anti-g system will be transferred to ASD/AEL for incorporation into aircrew systems of high-performance aircraft.

SUPPORTED BY U.S. Dept. of Defense, Air Force, School of Aerospace Medicine

6.0042, STEREO ACUITY

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The traditional decision point in ophthalmologic considerations regarding flying status has been differentiating those individuals with a phoria from those with a manifest deviation or tropia. Those with tropias (crossed eye) have not been qualified for flying status because of defective stereoscopic vision and their almost universal failure of the depth perception tests. A distinct category of patients between these two extremes has not been identified in the patient population of the Aeromedical Consulation Service. These individuals do indeed have a tropia but one of extremely small degree. These individuals do retain some degree of stereoscopic vision, and many can pass one of the USAF depth perception tests. The term developed for this type of disorder is 'microtropia.' Following a battery of motility testing procedures, a number of USAF flying personnel have been recommended for waiver for continued flying status. Since this is a totally new entity in the ophthalmologic field, the true nature of the process, its causes and ultimate prognosis -- i.e., progression to greater visual disability--are not yet clearly delineated. The objective of this work unit is to continue to follow such patients over time to provide the presently lacking new knowledge and to validate the established policy of continued flying for individuals with this condition. New stereoscopic testing equipment needs to be developed. Presently available testing devices are not sufficiently sensitive to carry out some of the tests desired.

Those USAF aircrew referred to the Ophthalmology Branch, Clinical Sciences Division, who have failed the USAF stereoscopic depth perception test will be put through an extensive battery of diagnostic tests to determine the cause of their failure. If the etiology of their failure is microtropia, they will be followed under this unit for aeromedical assessment regarding stability or progression. As new knowledge regarding this entity is developed, it will be transmitted to the field for utilization in all Air Force medical facilities and further disseminated to civilian and military ophthalmological community through publication of scientific papers. An attempt will be made to develop new and more refined stereoscopic testing devices by contractual effort. Work was formerly conducted under work unit 77550905.

SUPPORTED BY U.S. Dept. of Defense, Air Force, School of Aerospace Medicine

6.0043, USAF CENTRAL ECG LIBRARY

J.H. TRIEBWASSER, U.S. Air Force, School of Aerospace Med., *San Antonio, Texas* 78235 (DF322020)

Identify aircrew members having electrocardiographic abnormalities that are associated with potential risk in terms of sudden incapacitation/flying safety. Serve as a consultation service to the field in terms of interpretating and defining the significance of ECG findings, and the administrative aspects of the latter. Establish better criteria for the significance of specific electrocardiographic abnormalities in terms of aircrew selection and retention.

The routine review of the electrocardiograms on aircrew members and the consultation aspects of the USAF central ECG library are those outlined in AFR 160-43 and AFR 160-17. Long-term followup studies of specific electrocardiographic abnormalities will be conducted using questionnaires and the results of the medical evaluations within the Aeromedical Consultation Service. Methods for automating ECG interpretation, filing, and retrieval will be explored.

SUPPORTED BY U.S. Dept. of Defense, Air Force, School of Aerospace Medicine

6.0044, EVALUATING AND MINIMIZING NOISE IMPACT DUE TO AIRCRAFT FLYOVER

I.D. JACOBSON, Univ. of Virginia, School of Engin. & Appl. Sci., *Charlottesville, Virginia* 22903 (NSG 1509)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

MATHEMATICAL AND COMPUTER SCIENCES

Includes Mathematical and Computer Sciences (general); Computer Operations and Hardware; Computer Programming and Software; Computer Systems; Cybernetics; Numerical Analysis; Statistics and Probability; Systems Analysis; and Theoretical Mathematics.

7.0001, COOPERATIVE PHENOMENA IN THE INTERACTION OF MULTIMODE RADIATION WITH EXTENDED RESONANT MEDIUM

C.T. LEE, Alabama Agric. & Mech. Univ., School of Arts & Sciences, *Normal, Alabama* 35762 (DF042350; AF-AFOSR-2899-76)

Propagation of laser radiation through the atmosphere and other media is of great Air Force interest. This research will study the cooperative phenomena in the interaction of multimode radation with an extended resonant medium. This will be accomplished by a unified treatment of both superradiance and ultrashort pulse propagation, including fluctuation effects. He will use the Dicke-Schendimann representation, augmented by permutation symmetry consideration, to put the coupled superradiance master equations in a more explicit form, thus transforming these operator equations into c-number differential equations and study the conditions for superradiance, the superradiance effect on pulse propagation, and fluctuation effects. It is expected to explain the experimentally observed phenomena of ringing time delay. subsequently, an extension to a system of multilevel molecules will be performed which is relevant to the submillimeter laser system of CH3F.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

7.0002, ALGORITHMS FOR EFFICIENT MATRIX MULTIPLICATION

J. DEPILLIS, Univ. of California, Graduate School, *Riverside, California* 92502 (DF041360; AF-AFOSR-2858-75)

AF function - the study of the effects of nuclear detonation on aerospace vehicles, permanent structures and equipment. Deficiency - the numerical solution of the PDE's arising in these studies requires large numbers of matrix multiplications which are very expensive on computer time. Objective - this research intends to develop fast matrix multiplication algorithms and techniques for the efficient solution of linear systems. How work contributes - this research may generate algorithms and techniques which can be implemented into effective computer codes to reduce substantially the cost of computation.

This effort intends to develop fast algorithms and techniques for (1) reducing the number of scalar multiplications required to multiply rectangular matrices together, (2) solving a system of linear equations. In this area if a sequence of values obtained iteratively by a classical two-part splitting like Gauss-Seidel or SOR technique diverges, this sequence can be converted under certain conditions into a convergent sequence. If the original

sequence converges then, under certain conditions, such convergence can be accelerated. Cases in which the linear system is sparse or singular will be investigated.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

7.0003, NUMERICAL MODELING OF MAGNETOHYDRODYNAMIC CHANNEL FLOW
M.S. GREYWALL, Wichita State University, School of Engineering, *Wichita, Kansas* 67208 (NSG 3186)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

7.0004, DSF COMPUTER PROGRAM DETAILED REDESIGN
UNKNOWN, Computer Sciences Corporation, *Silver Spring, Maryland* 20910 (FA77NA-4011/3; FA160261 (TRAIS NO.))

Develop an operational specification for the DSF real-time system (Link 2). Redesign the Link 2 software so that it will be more flexible and easier to change when implementing new project requirements. To be included in this task is the development and implementation of an automated system to prepare input data for the Link 1 program.

SUPPORTED BY U.S. Dept. of Transportation, Federal Aviation Admin.

7.0005, SPECTRAL METHODS FOR COMPRESSIBLE FLOW PROBLEMS
S.A. ORSZAG, Mass. Inst. of Technology, School of Science, *Cambridge, Massachusetts* 02139 (DF049510; AF-AFOSR-3405-77)

AF function - the design of chemical laser devices, the design of jet engine and engine nacelles for future aircraft. Deficiency - these design problems are hampered by the lack of effective and efficient computational techniques to solve shock wave - boundary layer interaction problems. Objective - this effort will investigate the utility of the spectral methods in solving several classes of compressible flow problems and the application of results to the problem of shock wave -boundary layer interaction. How work contributes -techniques may be developed which are useful in solving problems in lasers and aircraft design.

This research involves the study of the properties of spectral methods for the numerical solution of systems of nonlinear hyperbolic equations with nonperiodic boundary conditions. A special case to be considered is the system of inviscid compressible Navier-Stokes equations. Questions of stability and convergence arising in connection with polynomial spectral methods will be investigated.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

7.0006, A GRAPH THEORETIC APPROACH TO FAULT-TOLERANT COMPUTING
W. HEIMERDINGER, Honeywell Incorporated, *Minneapolis, Minnesota* 55413 (DF040470; F44620-75-C-0053)

Air Force function - avionics systems are becoming the heart of almost all modern Air Force weapon systems. Deficiency - the growing central importance of the avionics system to overall system operation has highlighted the need for a systematic approach to avionics system design from a fault-tolerance viewpoint. Objective - the objectives of this research program are to expand existing fault-tolerant design theory to include the effects of time in fault-tolerant digital systems, and to develop a better representation of data in these systems. How work contributes - this research will contribute to the development of unified theory of fault-tolerance for analysis and synthesis.

The influence of time on the functional behavior of digital systems and on fault detection and fault recovery in these systems will be investigated and a formulation developed to reflect this influence in the fault-tolerance graph model. This would include determining when time is an important factor, documenting the assumption implicit in the incorporation of time in the model, developing the expanded model, and refining and evaluating the new model. In other work, the development of a representation for data in fault-tolerant systems will be initiated. This model will reflect three aspects of data handling - data access, data attributes, and data transformation.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

7.0007, NUMERICAL SOLUTION OF THE MEAN TURBULENT FLOW EQUATIONS FOR FLOW ABOUT ARBITRARY AIRFOILS
Z.U. WARSI, Mississippi St. University, School of Engineering, *Mississippi State, Mississippi* 39762 (DF042220; AF-AFOSR-2922-76)

AF function - the design of more effective reentry vehicles and conventional projectiles. Opportunity - new mathematical transformation techniques are presently available for use in the computation of complete flow fields. Objective - this research effort will utilize those transformation techniques and expand their utility to solve more complex flow problems. How work contributes - numerical techniques for the solution of mean turbulent flow equations for flows past arbitrary airfoil sections and for 3-d laminar flows will be developed for use by Air Force laboratories.

Investigation will continue in expanding results obtained under the current grant. During the present effort a numerical solution for two-dimensional flow has been developed using a two-equation turbulence model. A Kolmogorov-Saffman model used uses a Reynolds-stress closure based on an isotropic eddy viscosity. This model will be replaced by one in which the Reynolds-stress turbulence closure is obtained from the differential equations of the Reynolds-stresses themselves. This will greatly enhance the prediction capability for the 2-d flows. Body-fitted coordinate systems will be used in this investigation. A mathematical model for the mean turbulent flow will be studied. The transformed system of differential equations will be solved using methods like the accelerated Gauss-Seidel method of iteration. Efforts will be spent in the development of transformation and computational techniques for 3-D laminar flows.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

7.0008, NAVIER-STOKES NUMERICAL METHODS FOR CALCULATING HIGH REYNOLDS NUMBER SEPARATED FLOWS
P.J. ROACHE, Ecodynamics Res. Assoc. Inc., *Albuquerque, New Mexico* 87108 (DN575061; N00014-76-C-0636)

The effectiveness of aircraft, whether conventional or V/STOL, at low speeds is reduced by flow separation. The separation is caused by adverse pressure gradients induced by, for example, deflected control surfaces, high-incidence angles of the wings, or deflected jets. This research is a numerical approach, within the framework of the Navier-Stokes equations, for the development of a methodology to calculate low-speed separated flows with particular emphasis on high Reynolds numbers.

Flow separation at low speeds is an extremely complex phenomenon which can, at this time, be described in general only by detailed and tedious experiments or possibly by numerical calculations for an extremely limited set of special cases. Separation is beyond the scope of conventional boundary layer theory, and hence predictive procedures must rely on phenomenological modeling, higher order approximations, or numerical solutions of the Navier-Stokes equations. For high Reynolds number separated flows, special techniques must be developed for solving the Navier-Stokes equations such that the truncation errors in the convective terms do not swamp the complete viscous terms. This research will study the application of spectral methods to such problems, paying attention to the development of techniques for handling non-periodic data domains in periodic fashion with a finite number of continuous space derivatives at the boundaries. The periodic treatment is important from the viewpoint of developing a general methodology for broad classes of flow problems.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

7.0009, MATHEMATICAL PROBLEMS IN FLUID DYNAMICS
C.L. KELLER, U.S. Air Force, Flight Dynamics Lab., *Dayton, Ohio* 45433 (DF136320)

Present design methods for aircraft and missiles have great difficulties to predict the behavior of airfoils in the transonic region. The work investigates theoretically problems of transonic aerodynamics. Sometimes special features, as the junction of sonic line and shock, are studied but most of the work is done with a view towards improving the methods for computing the whole flow pattern. The work includes the development of background knowledge, in particular partial differential equations. The investigations are directed towards improving the numerical techniques, as well as the physical understanding of the phenomena in transonic flow fields. Spinoffs of similar numerical techniques to problems in stress and strain of aircraft structures will be explored.

The problem is treated under two different points of view, namely the study of properties of the partial differential equation and of its solutions which may be the cause of computational difficulties, and the direct study of numerical approaches. In the first part the nature of the solutions of typical boundary value problems will be investigated; In the second part a specific numerical technique will be examined with a view towards determining how well it or certain variants are suited to overcome the typical obstacles encountered in transonic flows. Another effort in aerodynamics is the computation of incompressible flow over multielement airfoils by means of an integral equation method (combined with preliminary conformal mappings). A related effort in this area is the proof of the adiabatic theorem for partial differential equations in two independent variables. Integral equation methods for the solution of the elastic problem in solid mechanics will be studied and then extended to elastic plastic problems.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

7.0010, NUMERICAL METHODS FOR PROBLEMS ON ENVIRONMENTAL EFFECTS IN AEROSPACE VEHICLES
R.S. VARGA, Kent State University, School of Arts & Sciences, *Kent, Ohio* 44242 (DF038960; AF-AFOSR-2729-74)

AF function - the design of chemical laser devices, the study of nuclear weapons effects on structures and aerospace vehicles. Opportunity - the use of pade approximants to develop computational algorithms for solving the stiff differential equations arising in the application areas listed above may provide useful tools to engineers and scientists in Air Force laboratories. Objective - this research intends to investigate the location of the zeros of certain functions, implicit Runge-Kutta methods for solving still systems of ordinary differential equations, the stability of such methods and to perform numerical experiments with these methods. How work contributes - techniques to be developed under this research effort may lead to the development of effective computational tools.

This research will examine the condition under which certain entire functions contain no zeros in specified parabolic regions in the complex plane. Will determine, if possible, a class of entire functions which with all its partial sums have no zeros in specified infinite regions of the complex plane. Implicit Runge-Kutta methods based on the repeated inversion of a fixed matrix will be investigated. In addition, numerical testing of the techniques developed will be accomplished.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

7.0011, NUMERICAL METHODS AND APPROXIMATION AND MODELLING PROBLEMS IN STOCHASTIC CONTROL THEORY
W.H. FLEMING, Brown University, Graduate School, *Providence, Rhode Island* 02912 (DF019590; AF-AFOSR-3063-76)

AF function - design of models of modern Air Force systems. Deficiency - the effects of imprecise mathematical descriptions (models) of the dynamics of such systems are poorly understood, and the resultant uncertainties undermine the capability of the control systems designed using the models. Objective - the objective of this research is to develop methodology for handling uncertain (stochastic) systems. How work contributes - achievement of this objective will provide methodology for improving control design for Air Force systems.

Research will proceed in six areas. First, a wide variety of mathematical numerical methods will be utilized for different forms of optimal stochastic control. Second, the treatment of average cost per unit time problem will be explored. Third, Monte Carlo optimization of stochastic systems will be investigated. Fourth, studies in long-term stochastics problems where noise effects are small, but dominate over a long period of time will be studied. Fifth, the study of quantitative properties when there is limited knowledge of the state of the system will be pursued. Finally, new methods for treating control problems for distributed systems will be investigated.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

7.0012, FINITE ELEMENTS FOR STRONGLY NONLINEAR PROBLEMS
R.E. JONES, Boeing Company, *Seattle, Washington* 98108 (DF044560; F44620-76-C-0130)

AF function - advanced aerospace vehicles require improved methods of analysis for nonlinear behavior. Deficiency - structural analysis techniques are not available to accurately and efficiently solve nonlinear structural problems. Objective - objective of this research is to investigate improved finite-element techniques for solving nonlinear structural behavior problems. How work contributes - research contributes to development of analysis and design methods in order to achieve higher performance, more durable flight vehicles.

Research will investigate two recent finite-element formulations. Triangular and quadrilateral plate or double curved elements will be considered which follow minimum potential energy formulations. These elements will be examined in the solution of problems involving large distortions. Accuracy of the elements will be studied by selecting six trial problems. Improvements in element models will also be studied and extensions to composite modeling examined. Finally, the evaluation of the efficiency and accuracy of trial problem solutions will be used to make qualitative recommendations as to when the proposed approach is more advantageous than competing procedures.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

PHYSICS

Includes Physics (general); Acoustics; Atomic and Molecular Physics; Nuclear and High-energy Physics; Optics; Plasma Physics; Solid-state Physics; Thermodynamics and Statistical Physics. For Related Information See Also Engineering.

8.0001, INFRARED TELESCOPE CRYOGENIC SYSTEM DESIGN AND DEVELOPMENT
G.R. KARR, Univ. of Alabama, School of Science & Engin., *Huntsville, Alabama* 35807 (NAS 8-32818)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

8.0002, FUNDAMENTAL EXPERIMENTS AT LIQUID HELIUM TEMPERATURES
W.M. FAIRBANK, Stanford University, School of Hum. & Sciences, *Palo Alto, California* 94305 (DF027070; F44620-75-C-0022)

AF function - the proposed research primarily falls in the 7.1 research objectives which deal with reconnaissance and surveillance. In particular the experiments involving the production and trapping of very low energy ground state electrons in a weak magnetic field lead to a photon-counting millimeter wave detector. Air Force operations require the search and mapping of regions of interest in real or near-real time in order to detect, identify, locate, count or investigate weapons, personnel, vehicles, installa-

tions by microwave, electronic and other sensing methods. Deficiency u the far infrared portion of the electromagnetic spectrum is an underdeveloped area that potentially could contribute significantly to remote sensing. This probable interaction of such radiation with materials along with high atmospheric transmission in many bands and especially at the longer wavelengths gives rise to interest regarding potential reconnaissance or surveillance application. Objective - the objective is to continue the development of the electron/positron thermalizer system and the photon-counting detector. At present, testing of a version of the thermalizer system which is suitable for use as a prototype photon-counting detector is being made. At the conclusion of the testing, coupling radiation from a thermal source to the detector to generate an order of magnitude estimate of the sensitivity and band width will be made. Contribution -this research is a part of a comprehensive program in low-temperature physics.

The approach during this contract period is to complete the current testing program on the photon counter. Then couple the photon counter to a blackbody radiation from a thermal source to the microwave cavity of the thermalizer. Radiation at the cyclotron frequency should excite to the m-1 cyclotron level of the thermalized trapped electrons, resulting in ejection of the electrons from the trap. By counting the number of ejected electrons as a function of source temperature, one should be able to obtain estimates of such parameters as detector noise temperature and efficiency. This electron/positron source configuration of the thermalizer will be assembled for the time-of-flight experiments. Also the study of the ambient fields present in the drift tube of the time-of-flight equipment at low temperatures will be done. (Text abridged.)

DTX* GQF-44790-1*

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

8.0003, RESEARCH IN SOLID-STATE ELECTRONICS 14749-EL

R.W. GOULD, Calif. Inst. of Technology, Graduate School, *Pasadena, California* 91109 (DA0F8958; DAAG29 77 C 0015)

Research to understand the physics, and to structurally and electronically characterize different layers of electronically active materials. The research will focus on interfaces between and surfaces of semiconducting materials. Relevance - a major portion of the electronic devices used in Army applications are derived from multilayers or heterojunctions of electronically active materials. This program will effectively contribute to the very important science and technology base of integrated circuits, millimeter- and micro-wave devices and night vision systems.

A theoretical and experimental investigation of (1) properties of abrupt GaAs/AlAs interfaces theoretically by LACO (linear combination of atomic orbitals) treatment and experimentally by optical means, (2) low-temperature epitaxial micro transport growth and characterization of heterojunctions, and (3) properties of surface layers exposed to ion implantation by channeling backscatter spectroscopy.

SUPPORTED BY U.S. Dept. of Defense, Army Materiel Development & Readiness Command, Army Research Office

8.0004, LOW-ENERGY ATOMIC COLLISIONS

R.H. NEYNABER, Intelcom Rad. Technology, *San Diego, California* 92138 (DF030140; F44620-74-C-0002)

AF function - this research contributes to RO 6.1, nuclear weapons effects. Deficiency - fireball codes require information on reaction rates for excited reactants and the kinetic and internal energy of the reaction products. Objective - to study selected reactions that will produce rewarding information on the kinetics of collisions and that can be expected to lead to general theoretical models. Contribution -useful information relat d to applications can be extracted from general theoretical models.

Merging beams and crossed beams apparatus are used for investigation of two-body, inelastic reactions including the determination of cross sections and mechanisms for the transfer of translational and internal energy of reactants into translational and internal energy of products.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

8.0005, MANY-BODY SOLID STATE

D.J. SCALAPINO, Univ. of California, School of Letters & Science, *Santa Barbara, California* 93106 (DMR76-17373 A01)

Research begun under NSF grant DMR73-07660 will be continued and extended, including studies of the physical properties of pseudo one-dimensional materials and phase transitions and related problems in quantum field theory. Specifically, techniques developed in the previous grant period will be applied to calculations of correlation functions for one-dimensional systems. Microscopic calculation of the parameters that enter the model Hamiltonians will be undertaken. Work on the mapping of a two-dimensional classical field problem into a one-dimensional quantum field theory problem will be pursued. Non-perturbative solutions to these quantum field theories will be investigated.

SUPPORTED BY U.S. National Science Foundation, Div. of Materials Research

8.0006, RADIATION AND LASER POTENTIAL OF HOMO- AND HETERO-NUCLEAR RARE GAS DIATOMIC MOLECULES

W.C. WALKER, Univ. of California, School of Letters & Science, *Santa Barbara, California* 93106 (DF046700; AF-AFOSR-3137-77)

AF function - upper atmosphere effects on Air Force operations and advanced short-wavelength lasers. Deficiency - there is insufficient knowledge available of the spectroscopic properties of rare gas continua which occur in the vacuum ultraviolet region of the spectrum. Objective - study spectroscopically the electronic, vibrational and rotational structures of diatomic rare gas molecules. Determine accurate, molecular constants and potential energy curves for the ground and excited states. How work contributes - low-lying electronic states of homo- and heteronuclear rare gas diatomic molecules are of intrinsic importance in understanding long-range forces. In addition, these molecules are also of interest because they are a source of intense vacuum ultraviolet (VUV) radiation and are candidates for VUV laser systems.

For the purpose of studying the homo- and hetero-nuclear rare gas diatomics three spectroscopic methods will be employed - (1) absorption spectroscopy in the vacuum ultraviolet region, (2) emission spectroscopy in the visible and near ultraviolet region. Upper states of assumed bands can be excited by processes such as x x m to x2 m and x2 e to 2x** radiation among others, (3) emission spectroscopy in the VUV region.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

8.0007, CONTROLLED ATMOSPHERE ANNEALING OF ION IMPLANTED GAAS

D.H. LEE, Hughes Aircraft Company, *Torrance, California* 90509 (DF044790; F49620-76-C-0028)

AF function - microwave solid-state electronic devices are essential components of Air Force surveillance, electronic countermeasures and communications systems. Opportunity - microwave devices made from GaAs show great promise for operation in the high-frequency spectrum, and ion implantation promises to be the technique which will create special dopant profiles in GaAs and hence take full advantage of this promising material. Unfortunately, an annealing step is required in order to remove the damage caused by the ion implant, and present-day techniques (especially for n-type dopants) do not adequately provide for high electrical activation of the implanted dopants, protection of the GaAs surface, and protection from contaminants. Objective - the objective of this research is to develop a new annealing encapsulant which will overcome these objections to current techniques. How work contributes -this work will develop a high-purity, flowing hydrogen.arsenic atmosphere encapsulation technique in order to achieve high electrical conversion efficiencies, protection of the GaAs surface, and removal of possible contaminants.

The controlled atmosphere annealing procedure will be modified by increasing the arsenic vapor pressure up to a level approximately 1,000 times greater than that presently in use. This increase will be accomplished either by increasing the GaAs source temperature or by introducing a flow of arsine into the system. This increased arsenic pressure will be used to determine the effects of arsenic pressure on doping efficiencies and also to determine whether or not the surface doping of GaAs (e.g., As vacancies) is intrinsically affected by annealing in high or low arsenic over-pressures. Several techniques will be used to correct a trend of lower conversion efficiencies as the ion dose is reduced. The use of the CAT for producing higher conversion efficiencies for dual implants of sulphur and gallium (n-type) or beryllium and arsenic (p-type) will be investigated. In a second approach, the usefulness of the CAT in situations where a damage profile (via He or Ar implant) is introduced before the actual dopant will be assessed. The controlled atmosphere annealing of implanted p-type impurities will be studied. (Text abridged.)

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

8.0008, FIRST PRINCIPLES CALCULATION OF FERROELECTRIC AND PIEZOELECTRIC SOLIDS

J.H. HENKEL, Univ. of Georgia, School of Arts & Sciences, *Athens, Georgia* 30602 (DF044180; AF-AFOSR-3045-76)

AF function - microwave solid-state electronic devices are essential components of Air Force surveillance, electronic countermeasures and communications systems. Opportunity - microwave devices made from GaAs show great promise for operation in the high-frequency spectrum, and ion implantation promises to be the technique which will create special dopant profiles in GaAs and hence take full advantage of this promising material. Unfortunately, an annealing step is required in order to remove the damage caused by the ion implant, and present-day techniques (especially for n-type dopants) do not adequately provide for high electrical activation of the implanted dopants, protection of the GaAs surface, and protection from contaminants. Objective - the objective of this research is to develop a new annealing encapsulant which will overcome these objections to current techniques. How work contributes -this work will develop a high-purity, flowing hydrogen.arsenic atmosphere encapsulation technique in order to achieve high electrical conversion efficiencies, protection of the GaAs surface, and removal of possible contaminants.

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SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

8.0009, DESIGN, DEVELOP, FABRICATE AND TESTING OF A SCIENTIFIC INSTRUMENT FOR AN EXPERIMENT TO MEASURE COSMIC RAY ISOTOPES

J.A. SIMPSON, Univ. of Chicago, School of Physical Sciences, *Chicago, Illinois* 60637 (NAS 5-24430)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

8.0010, HIGH FIELD TRANSPORT IN SEMICONDUCTORS

B.B. HOUSTON, U.S. Navy, Surface Weapons Center, *Silver Spring, Maryland* 20910 (DN585256)

Determine the high-electric-field properties of semiconductors important to naval applications, especially 3-5 semiconductors (alloys of Ga-In-P-As) and PbTe. High-field-transport phenomena are a crucial factor in determining the speed of devices and in predicting the applicability of a material in transferred electron devices.

Use pulsed electric fields to measure both current density and Hall effect as functions of electric field in thin films. Interpret the results as drift velocity vs. electric field and from this determine saturated drift velocity. Investigate the effect of the crystallographic orientation of the applied electric field. Dynamic instabilities in the thin films will be studied by use of capacitance probe techniques to determine electric-field distribution as functions of time and position. Photolithography and etching techniques will be developed for appropriately shaping films for these experiments.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

8.0011, HIGHLY EXCITED ATOMS

D. KLEPPNER, Mass. Inst. of Technology, School of Science, *Cambridge, Massachusetts* 02139 (DF034500; F44620-72-C-0057)

AF function - this research effort is concerned with the investigation of very high lying atomic levels. These states of are great interest because of their large polarizabilities and stark shifts, low ionization potentials and large dimensions. This study of highly excited atoms can lead to new techniques for detecting millimeter and infrared radiation for application to communications and plasma diagnostics, for example. Opportunity - this study of single highly excited atomic states presents opportunities for studying a variety of phenomena involving atoms and radiation, including: photoionization processes, tunneling phenomena in static and oscillating fields, and resonance phenomena. It also permits the study of collision in highly excited species and of level crossing dynamics which are important in many inelastic atomic and molecular collisions. Objective - the goal of this effort is to complete the study of field ionization in alkali one-electron systems, and to investigate field ionization in hydrogen. Contribution - work on highly excited atoms is a very active field. The process of tunneling in an electric field of a one-electron atom has been observed in detail and the measured rates were found to be in serious disagreement with hydrogenic theory. The continuing effort will investigate tunneling in alkalies, particularly on effects of level mixing. Other work will include experiments on the Landau-Zever effect, and the creation of Rydberg states of hydrogen, and a theoretical study of tunneling in alkalies.

The study of field ionization of sodium has shown that the theory developed for hydrogen is totally inadequate to deal with most levels of other one-electron atoms. A comprehensive theory for field ionization of a one-electron system in a non-coulombic system is needed and will be pursued in this effort. In parallel with this, the experimental investigation of field ionization rates will be extended. Ionization rates for Rydberg states of hydrogen will be measured. Fine structure effects break the exact symmetry of the non-relativistic model and lead to level mixing effects which may play a major role in the ionization process. Many inelastic collision processes in diatomic molecular processes are explained simply in terms of non-adiabatic transitions at level anticrossings, caused by the relative motion of the atoms. (Text abridged.)

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

8.0012, MAGNETIC LPE CRYSTALLINE FILMS FOR SMALL BUBBLE DIAMETER CYLINDRICAL-DOMAIN MEMORY APPLICATIONS

M. KESTIGIAN, Sperry Rand Corporation, *Sudbury, Massachusetts* 01776 (DF044360; F44620-76-C-0121)

AF function - mass memories and laser deflectors are essential components of Air Force reconnaissance, surveillance, countermeasure, and communications systems. These components are

presently implemented using electromechanical devices which are deficient in untended reliability and lifetime. Opportunity - improved reliability and performance of solid-state mass memory and magneto-optic laser deflectors can be expected from use of higher anisotropy, higher mobility crystalline magnetic films grown by liquid-phase epitaxy. Objective - the objective of this research is to conceive, grow, and characterize new crystalline magnetic films with improved small bubbles properties or improved magnetooptic figures of merit. How work contributes - this research should yield optimized compositions from small bubble and magnetooptic laser deflector liquid-phase epitaxy crystalline films.

New crystalline liquid-phase epitaxy films compositions will be investigated for small bubble properties or magnetooptic figure of merit as a function of composition, growth conditions, and post treatment.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

8.0013, GROWTH OF HOMOGENEITY CHARACTERIZATION OF MERCURY CADMIUM TELLURIDE CRYSTALS
F.H. POLLAK, Yeshiva University, Graduate School, *New York, New York* 10033 (DF039430; AF-AFOSR-2714-74)

AF function - infrared detectors are essential solid-state components of Air Force reconnaissance and surveillance systems. Opportunity - presently, infrared materials are insufficiently understood to produce detectors with predictable responses. The development of improved infrared detectors requires a full understanding of the role defects, impurities and nonstoichiometry plays in the detection process and their optimum performance in detector arrays. Objective - to characterize and understand the lattice response and detection properties of synthesized and specially doped narrow band-gap compound semiconductors such as (Hg, Cd) Te systems having optimum detectivities in the spectral range of 8 to 14 micrometers. How work contributes - high-density infrared detector arrays could result from this new approach to crystal growth, characterization and understanding of the electronic structure and optical properties of narrow band-gap semiconducting compounds.

Characterization of electronic structure and optical properties is accomplished non-destructively by a unique wavelength modulated photoresponse and by electrolyte electroreflectance (EER) spectroscopy to analyze impurity centers and to recognize actual changes in composition across the surface of a wafer with a spatial resolution commensurate with the dimensions of the detector array. A new approach to the growth of highly uniform large (Hg, Cd) Te crystals involves the application of Peltier-induced liquid-phase epitaxy (LPE) and evaluating topographical variations in stoichiometry of the grown crystals.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

8.0014, NUCLEAR STRUCTURE THEORY
J.B. FRENCH, Univ. of Rochester, School of Arts & Sciences, *Rochester, New York* 14627 (EY-76-S-02-2171)

Our research program is, broadly, the development and application of nuclear theory, including nuclear structure and nuclear reactions. This involves the development of new general theoretical methods, as well as the detailed examination of particular nuclei or nuclear reactions. We are working in the following areas: 1) Shell-model spectroscopy. Theory of the effective interaction and other aspects of the shell-model from the many-body point of view. 2) Spectral distribution methods in complex nuclei, including level densities and strength distribution, as well as general studies of nuclear symmetries and statistical behavior. 3) Interactions of high-energy particles with nuclei, including the theory of nuclear reactions of elementary particles, as well as nuclear-structure aspects of particle-removal reactions.

SUPPORTED BY U.S. Dept. of Energy, Div. of High Energy & Nuclear Physics

8.0015, TURBULENCE AND STATISTICAL MECHANICS
R.J. DONNELLY, Oregon State Higher Educ. Sys., School of Liberal Arts, *Eugene, Oregon* 97401 (DF041640; AF-AFOSR-2880-76)

AF function - this proposed research primarily falls in the 4.2 and 5.3 research objectives which deal with the fundamental process of turbulence and cryogen cooling of superconductive rotating electrical power generators and pulsed superconductive energy storage systems. Liquid helium is a system obeying a two-fluid model having normal fluid and superfluid velocity fields. Motion in these fields may be laminar or turbulent. There is reason to think that turbulence in the superfluid will be qualitatively different than in the normal fluid because the vorticity obeys a quantum restriction. It may, therefore, also be ultimately simpler to describe. Deficiency - research is required on the fundamental process of turbulence and on the understanding of the mixing of two streams including the turbulence diffusion and dissipative mechanisms. Transition from laminar to turbulent flow is poorly understood and errors in transition location can greatly affect drag on the design of high-speed thermal protection systems. Objectives - it is planned to carry out research on the behavior of quantum fluids with particular emphasis on turbulent flow in liquid helium II. Particular interest is in finding ways to study the manner in which a tangle of quantized vortex line in the turbulent superfluid decays to become heat. Also ways in which equations of motion for rotating helium II can be developed are under investigation which can lead to a better understanding of problems like heat transfer. Contributions - this research is a part of a comprehensive program in low-temperature physics.

The approach used in this proposal is to study the fluctuations of total density of vortex lines and vortex annihilation rates. Second sound noise is a measure of the fluctuation of total density of lines while the capture and escape of negative ions by quantized vorticity is associated with both the fluctuations in vortex density and vortex annihilation rate. On the theory side it is clear that surface energy effects require further elucidation on the microscale, and further formalization on the continuum level. It is proposed to initiate such studies. Work on the problem of bound states of rotons to impurities in HeII will be done. Using extensions of the principal investigator's earlier methods of treating bound states, the binding of rotons to solvated He3 atoms and various kinds of ions in liquid helium will be obtained. (Text abridged.)

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

8.0016, LABORATORY STUDIES OF ATOMIC COLLISION PROCESSES 14656-P
M.A. BIONDI, Univ. of Pittsburgh, School of Arts & Sciences, *Pittsburgh, Pennsylvania* 15260 (DA0F8927; DAAG29 77 G0079)

To acquire reaction rate data for processes of importance in laser plasmas and to elucidate the nature of the atomic collision processes occurring in plasmas of the type encountered in gas lasers and in the ionosphere. Relevance - the program is relevant to the design of high-power closed-cycle electric carbon dioxide lasers and the middle atmospheric research program of the Atmospheric Sciences Laboratory.

The magnitudes of the recombination coefficients of complex ions such as CO(plus). CO, CO(plus). H sub 2 O, Xe3(plus), etc., and the variation with electron temperature will be studied over a wide range. The nature of cluster ion recombination processes will be investigated by using optical spectrometric techniques to characterize the final states produced by the recombination events. A drift tube will be used to study both dimer and polar molecule cluster ions and non-resonant charge transfer processes.

SUPPORTED BY U.S. Dept. of Defense, Army Materiel Development & Readiness Command, Army Research Office

8.0017, RESEARCH ON TURBULENCE IN PLASMAS
D.C. MONTGOMERY, Coll. of William & Mary, Graduate School, *Williamsburg, Virginia* 23185 (NSG 7416)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

8.0018, THE INFLUENCE OF AEROSOLS ON ELECTRIC PARAMETERS IN THE FREE ATMOSPHERE 14048-GS
D.J. HOFMANN, Univ. of Wyoming, School of Arts & Sciences, *Laramie, Wyoming* 82071 (DA0F8900; DAAG29 77 G0046)

To assess the degree of influence that the natural aerosol in the stratosphere has on electrical parameters such as ion density and conductivity. Relevance - the work directly supports research programs at the Atmospheric Sciences Laboratory and the Ballistic Research Laboratories relating to atmospheric effects upon communications, the high-energy laser and ballistic missile defense systems.

Construct a new and better instrument to reliably measure ion density from a balloon-borne platform to be launched from Laramie Station (41 degrees N). This new instrument, plus a dustsonde, will be used to make simultaneous balloon-borne soundings of small ion density and the aerosol concentration in the stratosphere. The corresponding structure and variation in the two profiles will be analyzed.

SUPPORTED BY U.S. Dept. of Defense, Army Materiel Development & Readiness Command, Army Research Office

SOCIAL SCIENCES

Includes Social Sciences (general); Administration and Management; Documentation and Information Science; Economics and Cost Analysis; Law and Political Science; and Urban Technology and Transportation.

9.0001, USAF-ASEE SUMMER FACULTY RESEARCH PROGRAM (WPAFB)
C.D. BAILEY, Ohio State University, School of Engineering, *Columbus, Ohio* 43212 (DF042910; F44620-76-C-0052)

AF function - advanced aerospace systems. Opportunity - stimulate an exchange of scientific and engineering ideas between participants and Air Force personnel. Objective - to increase the technology base in areas of research pertinent to the Air Force. How work contributes -form the basis for continuing research of interest to the Air Force at the participant's institution.

The proposed program will sponsor a summer faculty program at Wright-Patterson AFB, OH, at the following organizations: Wright Aeronautical Laboratories, Flight Dynamics Laboratory, Materials Laboratory, Aero-propulsion Laboratory, Avionics Laboratory, Aerospace Medical Research Laboratory, Human Resources Laboratory (Sys Div), Aeronautical Systems Division, HQ Air Force Logistics Command. The participants will be assigned to an ongoing research team and/or activity, and will have the opportunity to fully engage in the research. The participants' contributions will be reported in a final report at the end of the 10-week program. Up to 25 participants are expected.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

SPACE SCIENCES

Includes Space Sciences (general); Astronomy; Astrophysics; Lunar and Planetary Exploration; Solar Physics; and Space Radiation. For Related Information See Also Geosciences.

10.0001, GEOLOGICAL STUDIES IN PLANETOLOGY
R. GREELEY, Arizona State University, School of Liberal Arts, *Tempe, Arizona* 85281 (NSG 7415)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

10.0002, PIONEER VENUS DATA ANALYSIS
D.M. HUNTEN, Univ. of Arizona, Graduate School, *Tucson, Arizona* 85721 (NAS 2-9487)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

10.0003, MICROWAVE AND THEORETICAL STUDIES FOR COSMIC BACKGROUND EXPLORER (COBE) SATELLITE
G.F. SMOOT, Univ. of California, Lawrence Berkeley Laboratory, *Berkeley, California* 94720 (NAS 5-25007)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

10.0004, ANALYSIS OF CORONAL FLOW AND WAVE PHENOMENA DURING THE SOLAR OCCULTATION OF THE EARTH-VIKING RADIO LINK
G.L. TYLER, Stanford University, School of Engineering, *Palo Alto, California* 94305 (NCA 2-745811)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

10.0005, STABLE FREQUENCY SOURCE UTILIZING A SUPERCONDUCTING-CAVITY-STABILIZED OSCILLATOR
M.H. COHEN, Calif. Inst. of Technology, Graduate School, *Pasadena, California* 91109 (AST76-23634)

Very Long Baseline Interferometry (VLBI) is the technique in which two radio telescopes thousands of miles apart can be used together to resolve the finest details of distant radio sources. This is done by recording the signals from the separate telescopes along with timing information from a highly accurate clock and later playing back both tapes into a special processor. The success of the method depends upon the accuracy of the clocks at each telescope. Until now most telescopes have used hydrogen maser time standards which are quite expensive. A new type of standard based on a superconducting cavity stabilized oscillator will be developed for use at the Owens Valley Radio Observatory of the California Institute of Technology which does not have a hydrogen maser. The new standard will greatly improve the stability and sensitivity of VLBI observations made at the observatory and will be available to all qualified users.

SUPPORTED BY U.S. National Science Foundation, Div. of Astronomical Sciences

10.0006, SUPERNOVAE AND EXTRAGALACTIC RESEARCH
W.L. SARGENT, Calif. Inst. of Technology, Graduate School, *Pasadena, California* 91109 (AST76-81089 A01)

The programs to discover supernovae with the 18-inch Schmidt telescope at Palomar and to carry out various lines of extragalactic research on quasars and compact galaxies with the large reflectors at the Hale Observatories and elsewhere will be continued. The research is divided into main topics: a) Continuation of the Palomar Supernova Search, which has been responsible for two-thirds of the supernovae discovered in modern times; b) An exploratory program of three-color photographs with the 48-inch Schmidt telescope, designed to discover radio-quiet quasars with redshifts zem greater than or equal to 3.0; c) Continuing spectroscopic studies of quasar absorption lines, consisting of high-resolution coude work of relatively bright objects on the one hand and low-resolution surveys for statistical purposes on the other. The work will be done with the Image Photon Counting System developed by Dr. A. Boksenberg at University College, London, and with a new Reticon device devised by Dr. S. Shectman of the Hale Observatories.

This action provides additional funding and extends the duration of grant AST 76-81089.

SUPPORTED BY U.S. National Science Foundation, Div. of Astronomical Sciences

10.0007, INVESTIGATION OF THE INTERRELATIONSHIP BETWEEN DIRECT, DIFFUSE, AND TOTAL SOLAR RADIATION
G.N. WALTON, U.S. Army, Constr. Engin. Res. Lab., *Champaign, Illinois* 61820 (DA0Q8136)

The objective is to determine a simple algorithm based on measured data for decomposing total solar radiation on a horizontal surface into its direct and diffuse components.

The approach will be to use two solar pyranometers to measure total and diffuse radiation on a horizontal surface and a third pyranometer which can be tilted to establish the algorithm for recombining direct and diffuse radiation on horizontal surfaces. Sky conditions and cloud type will also be observed since they may be needed to establish a correlation. The effects of daily and seasonal changes in the sun's position will be established.

SUPPORTED BY U.S. Dept. of Defense, Office Chief of Engineers, Corps of Engineers

10.0008, DYNAMICAL INVESTIGATIONS OF GALACTIC STRUCTURE PROBLEMS
R.H. MILLER, Univ. of Chicago, School of Physical Sciences, *Chicago, Illinois* 60637 (AST76-14289)

A theoretical study to simulate by computer the processes that cause disk galaxies to take the shapes they do and how they can maintain those shapes as long as they must will be carried out. Disk galaxies include barred and normal spirals, strongly flattened SO's, ellipticals, and ring galaxies. Numerical experimentation with simulated disk galaxies is the best way at present to investigate a variety of important problems in galactic dynamics. The physical stability of spiral galaxies is not understood. The velocity dispersions required for stable models are much greater than observed in our galaxy in the solar neighborhood. The problems of how our Galaxy can be stable, or if it is stable, of how it can support a spiral pattern will be considered.

The computer simlations of the dynamics will be made into motion pictures to display the problems of galactic structure. The motion pictures and other graphical displays will help both scientists and the public understand the problems.

SUPPORTED BY U.S. National Science Foundation, Div. of Astronomical Sciences

10.0009, SUPERFLUIDITY IN NEUTRON STARS - DECOUPLING IN THE OLD COLD PULSARS
G. GREENSTEIN, Amherst College, Graduate School, *Amherst, Massachusetts* 01002

SUPPORTED BY Research Corp.

10.0010, MINERALOGY AND WEATHERING PROCESSES ON MARS
R.L. HUGUENIN, Univ. of Massachusetts, Graduate School, *Amherst, Massachusetts* 01002 (NSG 7405)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

10.0011, SEISMIC SCIENCES AND EXPERIMENTAL CONCEPTS FOR ACTIVE SEISMIC EXPERIMENT ON MARS
S.C. SOLOMON, Mass. Inst. of Technology, School of Science, *Cambridge, Massachusetts* 02139 (NSG 7438)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

10.0012, SOLAR ATMOSPHERIC DYNAMICS
R.F. STEIN, Michigan State University, School of Natural Sciences, *East Lansing, Michigan* 48824 (DF248840; F19628-77-C-0068)

AF function - communications, surveillance, detection, tracking. Deficiency - inadequate solar disturbance predictions. Objective - to determine the energy transport mechanisms operating that heat the solar corona and drive the solar wind. How research contributes - provides information on which solar functions, such as oscillations, give rise to coronal and solar wind flows.

Calculate the driving of the solar atmospheric (300 second) oscillation resulting from thermal overstability of acoustic and magnetic modes in the super-adiabatic convection zone and the propagation, refraction and dissipation of these oscillations in the solar corona. Such results can then be used to determine what photospheric oscillation configurations give rise to the solar wind.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

10.0013, ROCKET INVESTIGATION OF NEUTRAL ATMOSPHERE-IONOSPHERE COUPLING AND PLANETARY ELECTRODYNAMICS
M.C. KELLEY, Cornell University, School of Engineering, *Ithaca, New York* 14850 (NSG 6020)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

10.0014, THEORETICAL STUDIES IN ASTROPHYSICS
E.E. SALPETER, Cornell University, School of Physical Sciences, *Ithaca, New York* 14850

Research will be carried out on the destruction of interstellar dust grains during collisions between interstellar clouds, and on the formation of dust grains in the atmospheres of cool supergiants. The interpretation of observational data on planetary nebulae, with the aim of developing a theory of the expansion of the nebula, will be continued. Radiative cooling of supernova remnants, with special emphasis on X-ray emission lines, is now underway and will be pursued further. There will be studies on the nuclear physics and statistical mechanics of neutron star cooling, on the rotation of neutron stars, on the flow patterns of matter and radiation during neutron star accretion, and on possible instabilities during such accretion. Various projects will involve the dynamical evolution of globular clusters. The effects of a black hole at the center of the cluster will be considered. The decrease in ellipticities of globular clusters due to the escape of stars with excess angular momentum will be studied. Areas in observational cosmology to be treated will include a study of the spiral galaxies in and near the Virgo cluster, and a study of the density distribution of the cluster itself.

This is a continuation of work previously supported by NSF grant AST75-21153A01.

SUPPORTED BY U.S. National Science Foundation, Div. of Atmospheric Sciences

10.0015, IRRADIATION EFFECTS ON THE AIRLESS SOLAR SYSTEM BODIES DUE TO SOLAR HIGH-ENERGY PARTICLES AND COSMIC RAYS (ABBREV)
M.S. SPERGEL, City University of New York, Undergraduate School, *Jamaica, New York* 11432 (NSG 7433)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

10.0016, ULTRAVIOLET STUDIES OF REFLECTION NEBULAE
A.N. WITT, Univ. of Toledo, School of Arts & Sciences, *Toledo, Ohio* 43606 (NSG 7431)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

10.0017, LUNAR SEISMIC DATA ANALYSIS
Y. NAKAMURA, Univ. of Texas, Graduate School, *Galveston, Texas* 77550 (NSG 7418)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

10.0018, INVESTIGATION OF THE TIDAL STRUCTURE OF THE THERMOSPHERE AND MESOSPHERE
R.M. HARPER, Rice University, Graduate School, *Houston, Texas* 77001 (ATM77-20240)

This grant funds an investigation of the Tidal Structure of the Thermosphere and Mesosphere based on a unique data base. It will study further atmospheric variations with periodicities of from a few days to a month, a range for which there is a serious lack of information. Some of the known periodicities attributed to this range are: a 2 day periodicity in the mesospheric winds at mid-latitudes detected by meteor radars, the mixed Rossby-gravity and Kelvin waves of the equatorial stratosphere (4-5 and 10-15 days, respectively), the magnetic activity (27 days) and the lunar tide (28 days).

The stratospheric data is to be analyzed in collaboration with Professor S. Kato's group from Kyoto University during an extended visit by Dr. Harper to Japan. The thermospheric data will be analyzed later at Rice University.

The objectives of the analysis include to: determine the dominant periods and vertical structures of the oscillations with periods greater than one day in the stratosphere, mesosphere and lower thermosphere; determine the low latitude variation of neutral temperature and meridional wind associated with magnetic activity; and continue analysis of approximately 50 days of thermospheric data (gathered by Dr. Harper while at Arecibo) in order to better define the tidal oscillations of the thermosphere.

SUPPORTED BY U.S. National Science Foundation, Div. of Atmospheric Sciences

GENERAL

11.0001, TECHNICAL SERVICE OPERATIONS AND MATERIAL FOR PROCESSING AND CATALOGING OF MATERIAL
UNKNOWN, Columbia University, Graduate School, *New York, New York* 10027 (NAS 5-24452)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

11.0002, DEVELOPMENT AND EXECUTION OF A VISITOR AND TOUR PROGRAM
K.E. WIGGINS, Okla. St. Univ., School of Education, *Stillwater, Oklahoma* 74075 (NAS 2-9877)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

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01 AERONAUTICS (GENERAL)

N78-26047* + National Aeronautics and Space Administration, Washington, D. C.
AERONAUTICAL ENGINEERING: A CONTINUING BIBLIOGRAPHY, SUPPLEMENT 96
May 1978 128 p
(NASA-SP-7037(96)) Avail: NTIS HC E02 CSCL 01A

This bibliography lists 448 reports, articles, and other documents introduced into the NASA scientific and technical information system in April 1978. Author

N78-26048*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SUMMARY OF NASA LANDING-GEAR RESEARCH
B. D. Fisher, R. K. Sleeper, and S. M. Stubbs Mar. 1978 34 p refs
(NASA-TM-78679) Avail: NTIS HC A03/MF A01 CSCL 01C

This paper presents a brief summary of the airplane landing gear research underway at NASA. The technology areas include: ground handling simulator, antiskid braking systems, space shuttle nose-gear shimmy, active control landing gear, wire brush skid landing gear, air cushion landing systems, tire/surface friction characteristics, tire mechanical properties, tire-tread materials, powered wheels for taxiing, and crosswind landing gear. This paper deals mainly with the programs on tire-tread materials, powered wheel taxiing, air cushion landing systems, and crosswind landing gear research with particular emphasis on previously unreported results of recently completed flight tests. Work in the remaining areas is only mentioned. Author

N78-26049# Advisory Group for Aerospace Research and Development, Paris (France).
GUIDANCE AND CONTROL DESIGN CONSIDERATIONS FOR LOW-ALTITUDE AND TERMINAL-AREA FLIGHT
Apr. 1978 316 p refs Papers presented at Guidance and Control Panel Symp., Dayton, Ohio, 17-20 Oct. 1977
(AGARD-CP-240; ISBN-92-835-1278-2) Avail: NTIS HC A14/MF A01

Navigational problems and collision avoidance are considered for low altitude and terminal area flights. Operational problems, terrain following, terminal area, landing, weapon delivery, and system integration are included. For individual titles, see N78-26050 through N78-26073.

N78-26050# Ministry of Defence, London (England).
GUIDANCE AND CONTROL FOR LOW LEVEL OFFENSIVE AIRCRAFT: A ROYAL AIR FORCE VIEW **c08**
G. A. Barnes *In* AGARD Guidance and Control Design Considerations for Low-Altitude and Terminal-Area Flight Apr. 1978 5 p (For availability see N78-26049 17-01)
Avail: NTIS HC A14/MF A01

The operational requirements for guidance and control systems for offensive aircraft, in the central region of Europe, depend both on the weapon delivery accuracy and on the penetration tactics and weapon delivery profiles. The profiles are affected by the enemy's anti-aircraft defense system and by weather conditions. Possible parameters are suggested for aircraft use in counter air, interdiction, and close air support roles. J.A.M.

N78-26051# National Aerospace Lab., Amsterdam (Netherlands).
THE GROUND-ATTACK/PENETRATION MODEL: A MONTE CARLO SIMULATION MODEL TO ASSESS THE SURVIVABILITY AND TO EVALUATE TACTICS FOR LOW-ALTITUDE MILITARY MISSIONS IN AN ENVIRONMENT OF GROUND-BASED AIR DEFENCE SYSTEMS **c05**
M. H. W. Bovy *In* AGARD Guidance and Control Design Considerations for Low-Altitude and Terminal-Area Flight Apr. 1978 5 p refs (For availability see N78-26049 17-01)
Avail: NTIS HC A14/MF A01

In the ground attack/penetration model, the following sets of parameters, each describing an essential component of the aircraft defense system interaction, were established: (1) defense system data (such as detection performance data, fire control computer performance data, missile data); (2) environmental factors (such as terrain features, meteorological conditions); and (3) aircraft characteristics (aircraft trajectory, radar cross section, ECM capabilities, etc.). This model was used for assessing aircraft vulnerability to air defense systems. J.A.M.

N78-26052# Technische Universitaet, Brunswick (West Germany).
OPEN-LOOP COMPENSATION OF WIND-SHEAR EFFECTS IN LOW LEVEL FLIGHT **c05**
Rudolf Brockhaus and Peter Wuest *In* AGARD Guidance and Control Design Considerations for Low-Altitude and Terminal-Area Flight Apr. 1978 19 p refs (For availability see N78-26049 17-01)
Avail: NTIS HC A14/MF A01

Since efficient closed loop control of wind shear produces high throttle activity, an open loop control law was developed that proved to be very efficient without the shortcomings of closed loop control. An open loop activation of throttle and spoilers was adequate to minimize the wind shear effects and thereby to discharge the closed loop system. A very simple Kalman filter with nonlinear limitation of the second derivative of wind velocity was found adequate to solve the separation problem. J.A.M.

N78-26053# Royal Aircraft Establishment, Farnborough (England). Flight Systems Dept.
AIRCRAFT RIDE-BUMPINESS AND THE DESIGN OF RIDE-SMOOTHING SYSTEMS **c08**
J. C. Jones and D. E. Fry *In* AGARD Guidance and Control Design Considerations for Low-Altitude and Terminal-Area Flight Apr. 1978 12 p refs (For availability see N78-26049 17-01)
Avail: NTIS HC A14/MF A01

Aircraft longitudinal ride-bumpiness due primarily to aircraft rigid-body response is discussed. Results for flight at high speeds and low altitude are described and the implications for aircraft design deduced, both in terms of basic airframe considerations and the use of active controls. Bumpiness is distinguished from vibration, the former being characterized by a sequence of

separately identifiable g fluctuations, referred to as bumps, the latter being associated with quasi-sinusoidal oscillations. Using statistical discrete gust theory, bumpiness is described in terms of g counts per unit time. In addition to providing a quantitative measure of exceedance counts of arbitrary g levels, this theory allows the straightforward computation of the sharpness of a bump in the sense of the rise-time of a typical discrete fluctuation in normal acceleration. J.A.M.

N78-26054# Northrop Corp., Hawthorne, Calif. Aircraft Group.

FLIGHT CONTROL SYSTEM DESIGN FOR RIDE QUALITIES OF HIGHLY MANEUVERABLE FIGHTER AIRCRAFT c08

J. F. Moynes and J. T. Gallagher *In* AGARD Guidance and Control Design Considerations for Low-Altitude and Terminal-Area Flight Apr. 1978 21 p refs (For availability see N78-26049 17-01)

Avail: NTIS HC A14/MF A01

A flight control system design is presented that utilizes a ride improvement mode system (RIMS) in conjunction with a control augmentation system to achieve desired ride smoothing for low altitude high speed flight conditions. The large amplitude flight simulator and the continuous system modeling program were used as the tools to analyze and evaluate ride qualities of a highly maneuverable fighter aircraft in low altitude, high speed flight conditions. Analysis included the effect of the first body bending mode on ride quality and pilot evaluations of the RIMS as flown on the large amplitude flight simulator. It is demonstrated that significant improvement in ride quality on a low wing loaded multipurpose combat airplane could be achieved without adverse impact on the handling qualities. J.A.M.

N78-26055# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. Fuer Flugfuehrung.

FLIGHT PERFORMANCE AND PILOT WORKLOAD IN HELICOPTER FLIGHT UNDER SIMULATED IMC EMPLOYING A FORWARD LOOKING SENSOR c54

R. Beyer *In* AGARD Guidance and Control Design Considerations for Low-Altitude and Terminal-Area Flight Apr. 1978 9 p refs (For availability see N78-26049 17-01)

Avail: NTIS HC A14/MF A01

A study was made giving particular emphasis to flight performance and pilot workload in flights under simulated IMC, employing a forward looking sensor, as well as to the layout of the display and the sensor system. The experiments were flown in a Bell UH-ID helicopter. The technical approach and some results are presented. J.A.M.

N78-26056# Forschungsinstitut fuer Anthropotechnik, Meckenheim (West Germany).

HUMAN ENGINEERING EVALUATION OF A COCKPIT DISPLAY/INPUT DEVICE USING A TOUCH SENSITIVE SCREEN c54

Klaus-P Gaertner *In* AGARD Guidance and Control Design Considerations for Low-Altitude and Terminal-Area Flight Apr. 1978 13 p refs (For availability see N78-26049 17-01)

Avail: NTIS HC A14/MF A01

A cockpit touch input/output system is described which integrates and combines several control and display functions of airborne systems into one space which can be located in the primary control and display areas of the cockpit. This integration is accomplished by the use of touch sensitive virtual switching arrays on a CRT driven by sophisticated computer software. Various technical approaches to the touch sensitive aspect of this system are described. The touch input control device and its possible application to airborne systems are discussed in terms of its advantages and reliability requirements. Several unique ergonomic problems associated with these devices are identified. A case history application for selected airborne systems involving use of menu-select hierarchies of virtual keyboards is presented. J.A.M.

N78-26057# Stuttgart Univ. (West Germany). Inst. Fuer Flugnavigation.

PROPOSAL FOR A COST EFFECTIVE RADAR NAVIGATION SYSTEM FOR LOW ALTITUDE AND TERMINAL AREA FLIGHT c04

E. Wildermuth *In* AGARD Guidance and Control Design Considerations for Low-Altitude and Terminal-Area Flight Apr. 1978 13 p refs (For availability see N78-26049 17-01)

Avail: NTIS HC A14/MF A01

The combination of already existent, well proved, and reliable navigational components or systems may be integrated to an effective navigation system. The usefulness of this concept was demonstrated on a practical example, where a dead reckoning navigation system and a radar set, belonging to the navigation equipment of a close support aircraft, were integrated to a cost effective radar navigation system. The utility and advantage of this system were proved in navigation test flights. Results showed that the system could be a valuable navigational aid for low altitude and terminal area flight. J.A.M.

N78-26058# British Aircraft Corp., Preston (England). Military Aircraft Div.

DESIGN CONSIDERATIONS FOR A GROUND AVOIDANCE MONITOR FOR FIGHTER AIRCRAFT c06

D. A. Whittle *In* AGARD Guidance and Control Design Considerations for Low-Altitude and Terminal-Area Flight Apr. 1978 13 p refs (For availability see N78-26049 17-01)

Avail: NTIS HC A14/MF A01

The problem of ground avoidance, as a consequence of maneuvers executed by fighter aircraft, is considered, and a relatively simple form of monitor is proposed to provide a pilot warning in the event of the aircraft being subjected to a hazardous trajectory. The parametric requirements of the ground avoidance monitor are discussed, along with difficulties associated with selection of suitable and available sensors. J.A.M.

N78-26059# Marconi-Elliott Avionic Systems Ltd., Rochester (England). Flight Control Div.

SYSTEM INTEGRATION AND SAFETY MONITORING TO ACHIEVE INTEGRITY IN LOW ALTITUDE FLIGHT CONTROL SYSTEMS c08

D. Sweeting *In* AGARD Guidance and Control Design Considerations for Low-Altitude and Terminal-Area Flight Apr. 1978 16 p refs (For availability see N78-26049 17-01)

Avail: NTIS HC A14/MF A01

Problems of monitoring the key flight control system elements were examined, in particular the primary terrain following (TF) sensor. The TF sensors are proposed that take advantage of the digital computing system capability (which was not available on first generation TF sensors). Improvements in navigation systems, such as strapdown IN and NAVStar when combined with stored map information, can be employed during low altitude operation to warn of hazardous situations relative to terrain. J.A.M.

N78-26060# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.

TERRAIN FOLLOWING CRITERIA: THE NEED FOR A CANNON MEASURE c06

A. F. Barfield *In* AGARD Guidance and Control Design Considerations for Low-Altitude and Terminal-Area Flight Apr. 1978 13 p (For availability see N78-26049 17-01)

Avail: NTIS HC A14/MF A01

A research program was undertaken to organize meaningful terrain following criteria. The standards were required to be independent of system mechanization. Initially, a literature search was conducted to obtain data on various terrain following systems and previously used criteria. Terrain following concepts were categorized and used to define common system elements that would be considered in the study. Criteria were then established based on this previous work and a current simulation effort. Performance measures were quantified and a performance index established. The performance index, in conjunction with a checklist, provided a means of comparing terrain following techniques. A handbook was then formulated but remains to be validated before incorporation into applicable Air Force Specifications. The proposed criteria are intended for use not only in writing terrain following system specifications, but also in determining terrain following equipment design, equating and ranking alternate terrain following methods, and allowing the merits of modifications to be assessed. J.A.M.

N78-26061# Air Force Flight Test Center, Edwards AFB, Calif.
B-1 TERRAIN-FOLLOWING DEVELOPMENT c06
Charles W. Brinkley, Patrick S. Sharp, and Richard Abrams (Rockwell International, Edwards, Calif.) *In* AGARD Guidance and Control Design Considerations for Low-Altitude and Terminal-Area Flight Apr. 1978 13 p (For availability see N78-26049 17-01)
Avail: NTIS HC A14/MF A01

The B-1 terrain following (TF) system and low altitude penetration capabilities were evaluated. The B-1 mission, flight test program goals, and test philosophy are discussed. The operating theory of the TF system is outlined, including the forward looking radar, TF computer, radar altimeter, TF/flight control system adapter, automatic throttle system, and autopilot. Ground tracking requirements and types of maneuvers flown are also considered. J.A.M.

N78-26062# Royal Aircraft Establishment, Bedford (England). Operational Systems Div.
STEEP GRADIENT APPROACH SYSTEMS RESEARCH FOR ALL-WEATHER OPERATIONS c04
A. D. Brown *In* AGARD Guidance and Control Design Considerations for Low-Altitude and Terminal-Area Flight Apr. 1978 15 p refs (For availability see N78-26049 17-01)
Avail: NTIS HC A14/MF A01

Some aspects are described of steep gradient approach research carried out at RAE Redford using flight trials, piloted simulation and theoretical studies. Because only conventional aircraft were available, the flight program was oriented towards establishing the limitation of such types and their associated avionics equipment when used for R/STOL operations. Only performance data for the twin turbojet BAC 1-11 and the twin turboprop HS 748 are presented. Aspects considered include the determination of the maximum useable glideslope angle and the optimum bandwidths for azimuth and elevation ratio guidance to permit R/STOL operations using a standard autopilot. It is suggested the MLS with DME range information will overcome some of the limitations identified. Manual approach performance results are also presented which indicate the need for 150-200 ft decision heights. Piloted simulation research has shown a requirement for approach lighting comparable to existing Category 2 patterns for poor visibility operations. Even then, it is unlikely that acceptable missed approach rates can be achieved unless RVRs are in excess of 1000 metres. L.S.

N78-26063*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va. Flight Research Div.
RECENT FLIGHT TEST RESULTS USING AN ELECTRONIC DISPLAY FORMAT ON THE NASA B-737 c06
Samuel A. Morello *In* AGARD Guidance and Control Design Considerations for Low-Altitude and Terminal-Area Flight Apr. 1978 10 p refs (For availability see N78-26049 17-01)
Avail: NTIS HC A14/MF A01 CSCL 01D

The results of a flight evaluation of two electronic display formats for the approach to landing under instrument conditions. The evaluation was conducted for a baseline electronic display format and for the same format with runway symbology and track information added. The evaluation was conducted during 3 deg, manual, straight in approaches with and without initial localizer offsets. Flight-path tracking performance data and pilot subjective comments were examined with regard to pilot's ability to capture and maintain localizer and glideslope using both display formats. The results of the flight tests agree with earlier simulation results and show that the addition of a perspective runway symbol with an extended centerline and relative track information to a baseline electronic display format improved both lateral and vertical flight-path tracking. Pilot comments indicated that the rental workload required to assess the approach situation was reduced as a result of integrating perspective runway with extended centerline along with relative track information into the vertical situation display. L.S.

N78-26064*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AIRLINE PILOT SCANNING BEHAVIOR DURING APPROACHES AND LANDING IN A BOEING 737 SIMULATOR c33
Amos A. Spady, Jr. *In* AGARD Guidance and Control Design Considerations for Low-Altitude and Terminal-Area Flight Apr. 1978 5 p refs (For availability see N78-26049 17-01)
Avail: NTIS HC A14/MF A01 CSCL 05J

A series of approaches using airline-rated Boeing 737 pilots in an FAA qualified simulator was conducted. The test matrices include both manual and coupled approaches for VFR, Category 1 and Category 2 conditions. A nonintrusive oculometer system was used to track the pilot's eye-point-of-regard throughout the approach. The results indicate that, in general, the pilots use a different scan technique for the manual and coupled (auto-pilot with manual throttle) conditions. For the manual approach 73 percent of the time was spent on the Flight Director and 13 percent on airspeed as opposed to 50 percent on Flight Director and 23 percent on airspeed for the coupled approaches. For the visual portion of approach from less than 100m to touchdown or when the touchdown point came into view, the pilots tend to fixate on their aim or touchdown area until the flare initiation, at which time they let their eye-point-of-regard move up the runway to use the centerline lights for rollout guidance. L.S.

N78-26065# Analytic Sciences Corp., Reading, Mass.
EVALUATION OF DIGITAL FLIGHT CONTROL DESIGN FOR VTOL APPROACH AND LANDING c08
Paul W. Berry, John R. Broussard, and Robert F. Stengel (Princeton Univ., N. J.) *In* AGARD Guidance and Control Design Considerations for Low-Altitude and Terminal-Area Flight Apr. 1978 21 p refs (For availability see N78-26049 17-01)
Avail: NTIS HC A14/MF A01

Methods and results in the design and evaluation of a digital flight control system (DFCS) for a CH-47B helicopter are presented. The DFCS employs proportional-integral control logic to provide rapid, precise response to automatic or manual guidance commands while following conventional or spiral-descent approach paths. It contains attitude- and velocity-command modes, and it adapts to varying flight conditions through gain scheduling. Extensive use is made of linear systems analysis techniques -- the DFCS is designed using linear-optimal estimation and control theory and the effects of gain scheduling are assessed by examination of closed-loop eigenvalues and time responses. The pre-flight-test evaluation described provides a direct comparison of alternate navigation, guidance, and control philosophies; confirms the practical merits of the DFCS design approach; and demonstrates techniques which will aid the development of future guidance and control systems. L.S.

N78-26066*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AUTOMATIC FLIGHT PERFORMANCE OF A TRANSPORT AIRPLANE ON COMPLEX MICROWAVE LANDING SYSTEM PATHS c04
Thomas M. Walsh and Earl F. Weener (Boeing Co., Seattle) *In* AGARD Guidance and Control Design Considerations for Low-Altitude and Terminal-Area Flight Apr. 1978 12 p refs (For availability see N78-26049 17-01)
Avail: NTIS HC A14/MF A01

During this demonstration the microwave landing system was utilized to provide the terminal configured vehicle B-737 airplane with guidance for automatic control on complex, curved descending paths with precision turns into short final approaches terminating in landing and roll-out, even when subjected to strong and gusty tail- and cross-wind components and severe wind shear. The data collected from more than fifty approach flights during the demonstration provided an opportunity to analyze airplane flight performance on a statistical basis rather than on a single flight record basis as is customarily done with limited data replication. Mean and standard deviation data are presented for approach flight path tracking parameters. In addition, the adverse wind conditions encountered during these flights are described using three-dimensional wind vector characteristics computed from the extensive on-board sensor data. L.S.

N78-26067# Centre d'Etudes et de Recherches, Toulouse (France).
ACCURATE TIMING IN LANDINGS THROUGH AIR TRAFFIC CONTROL c04
Marc Pelegrin and Nicole Imbert *In* AGARD Guidance and

Control Design Considerations for Low-Altitude and Terminal-Area Flight Apr. 1978 14 p refs (For availability see N78-26049 17-01)
Avail: NTIS HC A14/MF A01

In order to increase the accuracy of the landing time, corrections of speed and heading to be made during the approach of the aircraft are proposed. Numerical simulations including instrumentation, localization, navigation errors and wind were performed for four different aircraft on four approach trajectories. The comparison of the results of 200 simulations in each case, with and without the corrections, point out the improvement of the accuracy of the landing time due to these corrections. Flight tests also were made on commercial flights and the results of these tests are included. L.S.

N78-26068# Army Avionics Research and Development Activity, Fort Monmouth, N. J.
PROPAGATION INTEGRITY FOR MICROWAVE INSTRUMENT LANDING SYSTEMS **c04**
Paul S. Demko *In* AGARD Guidance and Control Design Considerations for Low-Altitude and Terminal-Area Flight Apr. 1978 8 p refs (For availability see N78-26049 17-01)
Avail: NTIS HC A14/MF A01

Testing at airfields at microwave landing system frequencies, using typical realistic multipath geometries and prototypical microwave landing system antenna radiation patterns, indicated the existence of a multipath problem that must be reckoned with if the next generation microwave landing system, whatever it may be, is to provide the utmost in operational utility and safety. There is strong evidence to support a contention that the choice of the correct polarization is fundamentally the surest way to relieve the next generation precision approach and landing systems from the burden of unnecessary multipath signals. The data weigh heavily in favor of circular polarization. L.S.

N78-26069# Standard Electrik Lorenz A.G., Stuttgart (West Germany).
DME-BASED SYSTEM FOR ENROUTE/TERMINAL NAVIGATION, ALL-WEATHER LANDING AND AIR TRAFFIC CONTROL **c04**
K. D. Eckert *In* AGARD Guidance and Control Design Considerations for Low-Altitude and Terminal-Area Flight Apr. 1978 13 p (For availability see N78-26049 17-01)
Avail: NTIS HC A14/MF A01

An analysis is given of the various subsystems of the DME system detailing its advantages over other installations. The areas of operational performance and economic efficiency are studied. L.S.

N78-26070# National Aerospace Lab., Amsterdam (Netherlands).
THE ANALYSIS OF OPERATIONAL MISSION EXECUTION: AN ASSESSMENT OF LOW-ALTITUDE PERFORMANCE, NAVIGATION ACCURACY AND WEAPON DELIVERY PERFORMANCE **c05**
T. J. Stahlie *In* AGARD Guidance and Control Design Considerations for Low-Altitude and Terminal-Area Flight Apr. 1978 10 p (For availability see N78-26049 17-01)
Avail: NTIS HC A14/MF A01

A description is given of characteristics of the mission analysis programs as carried out for the Royal Netherlands Air Force by the National Aerospace Laboratory. Although the program objectives can differ from trial to trial, they have a number of common properties: the use of onboard instrumentation/recording equipment, no need for ground equipment, specific, high accuracy, techniques for the determination of aircraft position with the aid of aerial photographs etc. All the programs are aimed at the analysis of relevant mission parameters, e.g. low-altitude performance, navigation accuracy, execution of attack maneuver, score of the (simulated) attack. Apart from this primary objective, the additional intentions are: a realistic training opportunity for fighter pilots, the evaluation of new tactics and the acquisition of realistic input data for simulation studies. The main point in the description is the technical set-up including instrumentation and data reduction techniques, calculation techniques applied and typical results obtained. L.S.

N78-26071*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EXPERIMENTAL DETERMINATION OF THE NAVIGATION ERROR OF THE 4-D NAVIGATION, GUIDANCE, AND CONTROL SYSTEMS ON THE NASA B-737 AIRPLANE **c04**
Charles E. Knox *In* AGARD Guidance and Control Design Considerations for Low-Altitude and Terminal-Area Flight Apr. 1978 14 p (For availability see N78-26049 17-01)
Avail: NTIS HC A14/MF A01 CSCL 17G

Navigation error data from these flights are presented in a format utilizing three independent axes - horizontal, vertical, and time. The navigation position estimate error term and the autopilot flight technical error term are combined to form the total navigation error in each axis. This method of error presentation allows comparisons to be made between other 2-, 3-, or 4-D navigation systems and allows experimental or theoretical determination of the navigation error terms. Position estimate error data are presented with the navigation system position estimate based on dual DME radio updates that are smoothed with inertial velocities, dual DME radio updates that are smoothed with true airspeed and magnetic heading, and inertial velocity updates only. The normal mode of navigation with dual DME updates that are smoothed with inertial velocities resulted in a mean error of 390 m with a standard deviation of 150 m in the horizontal axis; a mean error of 1.5 m low with a standard deviation of less than 11 m in the vertical axis; and a mean error as low as 252 m with a standard deviation of 123 m in the time axis. L.S.

N78-26072# Technische Universitaet, Brunswick (West Germany).
DIRECT LIFT CONTROL FOR FLIGHT PATH CONTROL AND GUST ALLEVIATION **c08**
Gunther Shaenzer *In* AGARD Guidance and Control Design Considerations for Low-Altitude and Terminal-Area Flight Apr. 1978 14 p refs (For availability see N78-26049 17-01)
Avail: NTIS HC A14/MF A01

Most of the results from the use of direct lift controls have not been very encouraging. The main reason for this is the coupling of desirable lift change with undesirable change of drag and pitch moment. This leads to unfavorable cross couplings with respect to handling qualities. Another reason is a design problem that can occur due to the high actuator rate, required for the DLC device. High actuator rate leads to high costs of the control actuator and actuator power supply as well as to drawbacks in the reliability of the system. An analysis is given to illustrate some of the problems, to point out the main cause of these problems and to indicate when DLC can be used successfully. L.S.

N78-26073# Elektronik-System G.m.b.H., Munich (West Germany).
NAVIGATION SYSTEM ASPECTS OF LOW ALTITUDE FLIGHT **c04**
Paul A. Bross *In* AGARD Guidance and Control Design Considerations for Low-Altitude and Terminal-Area Flight Apr. 1978 13 p (For availability see N78-26049 17-01)
Avail: NTIS HC A14/MF A01

The requirements deriving from accurate weapon delivery in enemy controlled areas are examined. Specifically, the requirements imposed on precision and integrity and safety are investigated. The need for an integration navigation system is stressed. Principal design criteria for low altitude flight are suggested. L.S.

N78-26074# Advisory Group for Aerospace Research and Development, Paris (France).
PERFORMANCE PREDICTION METHODS
May 1978 355 p refs Partly in ENGLISH and FRENCH Presented at Flight Mech. Panel Specialists Meeting on Performance Prediction Methods, Paris, 11-13 Oct. 1977 (AGARD-CP-242; ISBN-92-835-1282-0) Avail: NTIS HC A16/MF A01

Most of the analyses involve extrapolation of wind tunnel data to full scale flight conditions. In addition to performance prediction, the fields of flight mechanics, flight path optimization, and engine performance prediction are discussed. Pilot input and the question of performance method standardization are also

discussed. For individual titles, see N78-26075 through N78-26094.

N78-26075# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
PERFORMANCE METHODS FOR AIRCRAFT AND MISSILES **c05**
L. Earl Miller and Burtis R. Benson *In* AGARD Performance Prediction Methods May 1978 16 p refs (For availability see N78-26074 17-01)
Avail: NTIS HC A16/MF A01

Approximate closed form solutions are derived for a typical fighter mission. Also, flyout range and maneuvering requirements are derived for missiles. These solutions are suitable for the initial stages of preliminary design analysis. The state of the art of trajectory optimization and air to air analysis are reviewed. The development of singular perturbation theory has eliminated some of the numerical difficulties associated with two point boundary value problems. P.R.A.

N78-26076# Technische Hochschule, Darmstadt (West Germany). Fachgebiet Flugtechnik.
A SIMPLE CRITERION TO DISTINGUISH BETWEEN POINT AND INTEGRAL PERFORMANCE PROBLEMS AND ITS USE TO SIMPLIFY FLIGHT PROFILE OPTIMIZATIONS **c05**
Bernd Faber *In* AGARD Performance Prediction Methods May 1978 15 p refs (For availability see N78-26074 17-01)
Avail: NTIS HC A16/MF A01

Cookbook rules to simplify the mathematical model to a point performance problem and a procedure to its solution are given. Many flight-path optimization problems can be described adequately by such a point performance model. This will be demonstrated by two examples: the minimum time-to-climb path and the minimum-distance takeoff. P.R.A.

N78-26077# Technische Hogeschool, Delft (Netherlands).
PREDICTION OF OFF-DESIGN PERFORMANCE OF TURBOJET AND TURBOFAN ENGINES **c07**
H. Wittenberg *In* AGARD Performance Prediction Methods May 1978 31 p refs (For availability see N78-26074 17-01)
Avail: NTIS HC A16/MF A01

A simple method is developed to estimate the off-design performance of engines, fixed by the design point conditions. This method is based on gasdynamics relationships only and does not require a priori information from detailed fan, compressor or turbine performance maps. The method is based on the assumption of a choked exhaust nozzle or a choked turbine, through which the working points of the engine components upstream of these aerodynamic throats are developed. Single and two spool turbojet engines and two and three spool turbofan engines are considered. The calculation method is illustrated by some examples for existing engine types; the predicted off-design performance shows, at least, fair agreement with experimental and engine manufacturers data. P.R.A.

N78-26078# Technische Universitaet, Munich (West Germany). Lehrstuhl fuer Flugmechanik und Flugregelung.
THE ON-BOARD CALCULATION OF OPTIMAL CLIMBING PATHS **c05**
Gerhard Bruening and Peter Hahn (Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn, West Ger.) *In* AGARD Performance Prediction Methods May 1978 15 p refs (For availability see N78-26074 17-01)
Avail: NTIS HC A16/MF A01

Whereas subsonic aircraft perform their climbing flight phases according to optimal strategies in regular service, the corresponding strategies for supersonic aircraft are most difficult and time consuming to compute and tough to follow by the pilot, because complicated relations between altitude and Mach number must be observed. The methods developed so far are, therefore, not suitable for an application on-board the aircraft. Optimal climbing flight schedules computed by strong mathematical methods can be replaced to a high degree of accuracy by a series of arcs flown with constant load factor. The pertinent computer programs are simple and can be implemented with on-board computers. P.R.A.

N78-26079*# National Aeronautics and Space Administration, Washington, D. C.
PROPULSION-AIRFRAME INTERACTIONS PREDICTABILITY **c07**
Ronald H. Smith *In* AGARD Performance Prediction Methods May 1978 20 p refs (For availability see N78-26074 17-01)
Avail: NTIS HC A16/MF A01

An illustration of the possible magnitude of the transonic performance prediction problem is shown. These results derived from a careful and systematic set of tests run on a jet effects model, an aerodynamic and force model, and a pressure model, evaluated test techniques and wind tunnel effects. The results were then carefully compared with flight test data where significant discrepancies in zero-lift drag were observed. A vigorous review of the test techniques identified a number of potential error sources. Some of these were thought to be aircraft roughness and protuberances, tunnel anomalies, sting/model support corrections, and hot gas effects. In addition, there were questions on model metric splitline location and magnitude of corrections for scale and Reynolds number. Flight test inlet/engine characteristics were thought to differ, also, from those of the calibration settings in the ground facilities. P.R.A.

N78-26080# Messerschmidt-Boelkow G.m.b.H., Munich (West Germany). Unternehmensbereich Flugzeuge.
DRAG MEASUREMENT IN TRANSONIC WIND TUNNELS **c02**
Felix Awehla *In* AGARD Performance Prediction Methods May 1978 18 p refs (For availability see N78-26074 17-01)
Avail: NTIS HC A16/MF A01

In order to increase the accuracy it is recommended to take into account the simultaneously measured wall pressure. By linking these wall pressures with theoretical wall interference computations it seems possible to approach the absolute limit of accuracy. This requires, however, consideration of axial pressure gradients produced by the tunnel wall or by inappropriate model suspensions. An example shows that these pressure gradients can cause errors in the absolute pressure drag of more than 100% and even in the drag differences of about 20% respectively. The influence of Reynolds number on afterbody drag and on wing shock locations is critically reviewed and the variation of wind tunnel boundary layer is suggested as prime cause for these affects. Lastly, unsteady flow separation problems are briefly touched and general recommendations for improved drag assessment are made. P.R.A.

N78-26081# Royal Aircraft Establishment, Farnborough (England).
PERFORMANCE IMPLICATIONS OF SOME RECENT ADVANCES IN WEAPON CARRIAGE RESEARCH **c05**
L. Davies *In* AGARD Performance Prediction Methods May 1978 18 p refs (For availability see N78-26074 17-01)
Avail: NTIS HC A16/MF A01

The possibilities that exist, and are being developed, for reducing the drag penalties associated with the carriage of weapons on combat aircraft are discussed. Performance implications of drag reduction for large weapon loads are discussed, not only in terms of speed and radius of action for existing aircraft, but also in terms of sizing a new aircraft to attain a specified performance. P.R.A.

N78-26082# Hawker Siddeley Aviation Ltd., Kingston upon Thames (England).
VTOL PERFORMANCE ESTIMATION FOR JET LIFT AIRCRAFT **c05**
C. M. Milford *In* AGARD Performance Prediction Methods May 1978 10 p refs (For availability see N78-26074 17-01)
Avail: NTIS HC A16/MF A01

The development of a semi-analytical model for VTOL performance estimation is described. Only vertical motion is considered; the calculation takes account of engine acceleration time, changes in vehicle mass due to fuel flow, and the vertical drags due to aircraft motion. Hot gas recirculation and ground effects are obtained from temperature and force measurements on model test rigs. The calculated height-time histories show good agreement with measurements of actual aircraft VTOs: the available full scale VL data is more limited, but also shows satisfactory agreement with prediction. P.R.A.

N78-26083# Vereinigte Flugtechnische Werke-Fokker G.m.b.H., Bremen (West Germany).

COMPARISON OF ESTIMATED AND FLIGHT DATA FOR ROLLING TAKE-OFF AND TRANSITION OF A VTOL AIRCRAFT **c05**

Guenter Kollokowski and Richard Smyth *In* AGARD Performance Prediction Methods May 1978 19 p refs (For availability see N78-26074 17-01)

Avail: NTIS HC A16/MF A01

The accurate prediction of multi-engine VTOL-aircraft performance during rolling take-off and transition must take a larger number of parameters into consideration than conventional aircraft. These additional parameters are strongly interconnected and have a large influence of overall aircraft performance. A suitable performance prediction model will be defined for a lift plus lift cruised aircraft with two lift engine performance into account. The predicted results will be compared with data from flight test for typical railing take-off and transition operations. Author

N78-26084# British Aerospace Aircraft Group, Woodford (England). Manchester Div.

A COMPUTERIZED AIRCRAFT PERFORMANCE SYSTEM **c05**

John Richardson *In* AGARD Performance Prediction Methods May 1978 16 p (For availability see N78-26074 17-01)

Avail: NTIS HC A16/MF A01

The system, referred to as CAPS, is a group of computer programs or modules covering the essential elements of performance evaluation and prediction and also the subsequent processing of results. The relationship and interfaces of CAPS with other technical disciplines, for example, aircraft systems, power plant, flight test, and technical publications is discussed and the need to integrate CAPS into the overall design process is emphasized. The use of the system in conjunction with on-line terminals and interactive graphical visual display units is also discussed. P.R.A.

N78-26085# Avions Marcel Dassault-Breguet Aviation, Saint-Cloud (France). Div. des Etudes Avancees.

PERFORMANCE PREDICTIONS OF MARCELL DASSAULT-BREGUET AVIATION AIRCRAFT [PREVISIONS DES PERFORMANCES AUX AVIONS MARCEL DASSAULT-BREGUET AVIATION] **c05**

Pierre Bohn *In* AGARD Performance Prediction Methods May 1978 12 p In FRENCH (For availability see N78-26074 17-01)

Avail: NTIS HC A16/MF A01

Results of performance predictions for numerous Marcel Dassault-Breguet aircraft were examined, and reference was given to nominal and safety performances. Most of the performances measured were closely related to predictions, however, it was suggested that an improvement in methods of aerodynamic theory would reduce the present diversity in results. Transl. by B.B.

N78-26086# National Aerospace Lab., Amsterdam (Netherlands). Performance and Evaluation Dept.

PREDICTION OF OPERATIONAL COMBAT PERFORMANCE **c05**

H. Tellegen *In* AGARD Performance Prediction Methods May 1978 7 p (For availability see N78-26074 17-01)

Avail: NTIS HC A16/MF A01

There are indications that further improved performance of future fighter aircraft will no longer result into a proportional improvement in combat capability and that therefore, in order to obtain superior combat capability, other means must be found. One of these is to improve tactics and, in particular, assisting pilots in the execution of complex tactical maneuvers. This includes the design of maneuvers which are sound from a flight mechanics point of view and the identification of key points in the maneuver which can be handled by the pilot as reference, provided that he has available, in a suitable form, the required information with respect to the flight conditions. As an example of maneuver design a pitch-up type ground attack maneuver is considered. G.Y.

N78-26087# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).

ANALYSIS OF ERROR SOURCES IN PREDICTED FLIGHT PERFORMANCE **c05**

Michael Lotz and Heribert Friedel *In* AGARD Performance Prediction Methods May 1978 11 p (For availability see N78-26074 17-01)

Avail: NTIS HC A16/MF A01

The errors involved in the flight performance prediction before the first flight stem in the case of point performances (SEP, load factor etc.) from uncertainties in the prediction of aerodynamic and engine data and in the case of integral performances (take off, landing, climb etc.) also from improper assumptions in the procedures for their calculation. The results of an analysis of these errors are shown for a typical CAS aircraft. G.Y.

N78-26088# Office National d'Etudes et de Recherches Aerospatiales, Leclerc (France).

PREDICTION OF AERODYNAMIC CHARACTERISTICS OF AN AIRCRAFT FROM A CORRELATION OF RESULTS ON A CALIBRATION MODEL TESTED IN VARIOUS LARGE TRANSONIC TUNNELS **c05**

Ph. Poisson-Quinton and X. Vaucheret *In* AGARD Performance Prediction Methods May 1978 17 p refs In FRENCH; ENGLISH summary (For availability see N78-26074 17-01)

Avail: NTIS HC A16/MF A01

A program was initiated in 1969 to test a series of similar calibration models, representative of a transport aircraft, in various transonic tunnels of seven countries. The configuration was chosen to have a typical design Mach number (M approximately 0.84) for a transport aircraft, with very specific aerodynamic troubles at given Mach numbers and angles of attack, for the purpose of a precise comparison between various wind tunnel results on flight envelop prediction. This paper is restricted to the results obtained with the largest model, tested in the U.S.A., Canada, England, Holland, and France. The aerodynamic characteristics obtained are recalled to show that, in general, the results obtained are more and more misleading when the Reynolds number decreases below two (2) million. From this experiment, it is still impossible to define a magic Reynolds number above which there is no more effect on the aerodynamic characteristics. G.Y.

N78-26089# Naval Air Systems Command, Washington, D. C.

DEVELOPMENT OF TECHNIQUES AND CORRELATION OF RESULTS TO ACCURATELY ESTABLISH THE LIFT/DRAG CHARACTERISTICS OF AN AIR BREATHING MISSILE FROM ANALYTICAL PREDICTIONS, SUB-SCALE AND FULL SCALE WIND TUNNEL TESTS AND FLIGHT TESTS **c15**

E. C. Rooney and R. E. Craig (General Dyn./Convair, San Diego, Calif.) *In* AGARD Performance Prediction Methods May 1978 18 p refs (For availability see N78-26074 17-01)

Avail: NTIS HC A16/MF A01

The aerodynamic correlations provide information for validating or improving current lift/drag prediction techniques. Correlations for the various prediction/documentation procedures are presented for linear range lift variations with angle of attack, maximum drag, induced drag and skin friction drag over the subsonic and low transonic mach regimes. The correlations for lift and induced drag characteristics show generally good to excellent agreement. The minimum drag prediction procedures for transonic drag rise is poor for all prediction precedures compared to flight test. Analytical prediction methods and subscale model test results for subsonic minimum drag (which do not totally account for the effects of manufacturing tolerances, protuberances and excrescences) require an increase of approximately 8% to produce agreement with the minimum drag level obtained from powered full scale wind tunnel and flight tests. G.Y.

N78-26090# McDonnell Aircraft Co., St. Louis, Mo. Aerodynamics Dept.

FLIGHT TEST VERIFICATION OF F-15 PERFORMANCE PREDICTIONS **c05**

J. M. Abercrombie *In* AGARD Performance Prediction Methods May 1978 13 p refs (For availability see N78-26074 17-01)

Avail: NTIS HC A16/MF A01

The prediction of the performance characteristics of the F-15 Eagle was based primarily on data obtained in an extensive wind tunnel test program. This test program was designed to determine the basic lift and drag characteristics for all flight conditions. In addition, the effects of engine operating conditions

as reflected in inlet mass flow and engine nozzle geometry and jet plume characteristics were carefully measured. Inlet performance model tests served to provide accurate definition of recovery characteristics for calculation of net propulsive forces. The test techniques and the methods used to adjust the wind tunnel results to predicted flight performance are discussed. A description of the flight test program for performance with flight qualification is also included. Selected comparison of predicted performance with flight test results are presented. Assessment of the performance prediction methods used, based on the degree of verification available from flight test data, is also included. The results prove that with sufficiently sophisticated wind tunnel models and through test techniques, satisfactory performance predictions can be made. G.Y.

N78-26091# Northrop Corp., Hawthorne, Calif. Aircraft Group.
YF-17 FULL SCALE MINIMUM DRAG PREDICTION c05
H. W. Grellmann *In* AGARD Performance Prediction Methods May 1978 12 p (For availability see N78-26074 17-01)
Avail: NTIS HC A16/MF A01

The problem of predicting the full scale minimum drag of supersonic fighter aircraft is addressed. The YF-17 aircraft is used to illustrate the various factors which must be taken into account. Two comparisons of YF-17 minimum drag are presented. The first comparison is between analytical estimates and wind tunnel results. The second comparison is between the full scale predicted minimum drag based on wind tunnel data and the flight test drag level based on in-flight measured thrust. The data presented show in detail how the YF-17 full scale minimum drag was predicted. Areas of uncertainty are discussed which may contribute to the differences between the predicted and measured flight test minimum drag. G.Y.

N78-26092# General Dynamics/Fort Worth, Tex.
CORRELATION OF F-16 AERODYNAMICS AND PERFORMANCE PREDICTIONS WITH EARLY FLIGHT TEST RESULTS c05
T. S. Webb, D. R. Kent, and J. B. Webb *In* AGARD Performance Prediction Methods May 1978 17 p refs (For availability see N78-26074 17-01)
Avail: NTIS HC A16/MF A01

F-16 design objectives and pertinent configuration features are reviewed, and the major external configuration differences between the YF-16 prototype and the F-16 full-scale development airplanes are discussed. The approach to predicting F-16 aerodynamics was to use YF-16 flight-test-derived data corrected for YF-16-to-F-16 configuration differences as determined from wind tunnel tests. A comparison of YF-16 and F-16 wind tunnel lift, drag, and pitching-moment data reflects the close similarity between the F-16 and YF-16 configurations. Early F16 flight test results show similar differences between wind tunnel and flight test lift and drag as experienced on the YF-16 and, therefore, validate this empirical approach. The untrimmed drag due to lift generally appears lower in flight than in the wind tunnel, and the subsonic lift in the intermediate angle-of-attack range is higher inflight than in the wind tunnel. The trim horizontal-tail deflections, however, are larger than indicated by the wind tunnel, which was not the case for the YF-16 and therefore was not predicted. This results in a small increase in trim drag. G.Y.

N78-26093# Societe Nationale Industrielle Aerospatiale, Paris (France).
A COMPARISON OF PREDICTIONS OBTAINED FROM WIND TUNNEL TESTS AND THE RESULTS FROM CRUISING FLIGHT (AIRBUS AND CONCORDE) [COMPARISON ENTRE LES PREVISIONS DEDUITES DES ESSAIS EN SOUFLLERIE ET LES RESULTATS DE VOL EN CROISIERE (AIRBUS ET CONCORDE)] c05
J. Berger *In* AGARD Performance Prediction Methods May 1978 50 p refs In FRENCH (For availability see N78-26074 17-01)
Avail: NTIS HC A16/MF A01

A review of methods to establish aerodynamic and propulsion data is presented. Comparison was made between flight tests results and predictions made from the data. Various theories and improvements in the aerodynamic data are used to explain the slight deficiency found on the Airbus and Concord. Thrust characteristics, air flow and consumption in the gas generator assembly must be established. Transl. by B.B.

N78-26094# Lockheed-California Co., Burbank.
CORRELATION OF WIND-TUNNEL AND FLIGHT-TEST DATA FOR THE LOCKHEED L-1011 TRISTAR AIRPLANE c09
R. H. Hopps and E. C. B. Danforth *In* AGARD Performance Prediction Methods May 1978 12 p (For availability see N78-26074 17-01)
Avail: NTIS HC A16/MF A01

The methodology of prediction, and the degree of correlation between wind tunnel test and flight test results are presented. Included in the presentation are the general lift and drag characteristics, minimum airspeed, buffet characteristics, and static and dynamic longitudinal and lateral/directional stability characteristics. G.Y.

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer*.

N78-26095 Aeronautical Research Labs., Melbourne (Australia).
TRANSONIC WIND TUNNEL TESTS ON A NACA 0012 AEROFOIL
N. Pollock Apr. 1977 45 p refs
(ARL/Aero-Rept-148; AR-000-244) Copyright. Avail: Issuing Activity

Transonic wind tunnel tests on three geometrically similar NACA 0012 airfoil models are reported. The test which comprised surface pressure distribution and wake traverse measurements covered a Mach number range of 0.5 to 0.82 and an incident range of 0 to 8 degrees. The test Reynolds number for the three models were 1,680,000, 840,000 and 420,000 for the large, intermediate and small models, respectively. Brief tests on the two larger models at reduced Reynolds number were also included. All tests were conducted with artificial boundary layer transition fixing on both surfaces. The investigation was proposed to provide data to evaluate wall interference effects in the transonic wind tunnel. The data should also be helpful for checking the accuracy of interference theories at high subsonic speed. G.Y.

N78-26096*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECT OF TWIST AND CAMBER ON THE LOW-SPEED AERODYNAMIC CHARACTERISTICS OF A POWERED CLOSE-COUPLED WING-CANARD CONFIGURATION
John W. Paulson, Jr. and James L. Thomas May 1978 159 p refs
(NASA-TM-78722) Avail: NTIS HC A08/MF A01 CSCL 01A

A series of wind-tunnel tests were conducted in a V/STOL tunnel to determine the low-speed longitudinal aerodynamic characteristics of a powered close-coupled wing/canard fighter configuration. The data was obtained for a high angle-of-attack maneuvering configuration and a takeoff and landing configuration. The data presented in tabulated form are intended for reference purposes. Author

N78-26097*# Purdue Univ., Lafayette, Ind.
CALCULATION OF THE FLOW FIELD IN SUPERSONIC MIXED-COMPRESSION INLETS AT ANGLE OF ATTACK USING THE THREE-DIMENSIONAL METHOD OF CHARACTERISTICS WITH DISCRETE SHOCK WAVE FITTING
Final Report
Joseph Vadyak and Joe D. Hoffman Jun. 1978 252 p refs (Grants NGR-15-005-162; NGR-15-005-191)
(NASA-CR-135425; TSPC-78-1) Avail: NTIS HC A12/MF A01 CSCL 01A

The influence of molecular transport is included in the computation by treating viscous and thermal diffusion terms in the governing partial differential equations as correction terms

in the method of characteristics scheme. The development of a production type computer program is reported which is capable of calculating the flow field in a variety of axisymmetric mixed-compression aircraft inlets. The results agreed well with those produced by the two-dimensional method characteristics when axisymmetric flow fields are computed. For three-dimensional flow fields, the results agree well with experimental data except in regions of high viscous interaction and boundary layer removal. G.G.

N78-26098*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

COLD-AIR PERFORMANCE OF THE COMPRESSOR-DRIVE TURBINE OF THE DEPARTMENT OF ENERGY BASELINE AUTOMOBILE GAS-TURBINE ENGINE Final Report

Richard J. Roelke and Kerry L. McLallin Jul. 1978 24 p refs (Contract EC-77-A-31-1011)

(NASA-TM-78894; E-9480; DOE/NASA/1011-78/25) Avail: NTIS HC A02/MF A01 CSCL 01A

The aerodynamic performance of the compressor-drive turbine of the DOE baseline gas-turbine engine was determined over a range of pressure ratios and speeds. In addition, static pressures were measured in the diffusing transition duct located immediately downstream of the turbine. Results are presented in terms of mass flow, torque, specific work, and efficiency for the turbine and in terms of pressure recovery and effectiveness for the transition duct. Author

N78-26099*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

VSTOL TILT NACELLE AERODYNAMICS AND ITS RELATION TO FAN BLADE STRESSES

Robert J. Shaw, Robert C. Williams, and Joseph L. Koncsek (Boeing Mil. Airplane Develop.) Jul. 1978 15 p refs Proposed for presentation at the 14th Joint Propulsion Conf., Las Vegas, Nev., 25-27 Jul. 1978; sponsored by the AIAA and the Soc. of Automotive Engr.

(NASA-TM-78899; E-9635) Avail: NTIS HC A02/MF A01 CSCL 10A

A scale model of a VSTOL tilt nacelle with a 0.508 m single stage fan was tested in a low speed wind tunnel to ascertain inlet aerodynamic and fan aeromechanical performance over the low speed flight envelope. Fan blade stress maxima occurred at discrete rotational speeds corresponding to integral engine order vibrations of the first flatwise bending mode. Increased fan blade stress levels coincided with internal boundary layer separation but became severe only when the separation location had progressed to the entry lip region of the inlet. G.G.

N78-26100*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

A VISCOUS-INVISCID INTERACTIVE COMPRESSOR CALCULATIONS

William Johnston (Case Western Reserve Univ.) and Peter M. Sockol Jul. 1978 14 p refs Presented at 11th Fluid and Plasma Dynamics Conf., Seattle, Washington, 10-12 Jul. 1978; sponsored by AIAA

(NASA-TM-78920; E-9658) Avail: NTIS HC A02/MF A01 CSCL 01A

A viscous-inviscid interactive procedure for subsonic flow is developed and applied to an axial compressor stage. Calculations are carried out on a two-dimensional blade-to-blade region of constant radius assumed to occupy a mid-span location. Hub and tip effects are neglected. The Euler equations are solved by MacCormack's method, a viscous marching procedure is used in the boundary layers and wake, and an iterative interaction scheme is constructed that matches them in a way that incorporates information related to momentum and enthalpy thicknesses as well as the displacement thickness. The calculations are quasi-three-dimensional in the sense that the boundary layer and wake solutions allow for the presence of spanwise (radial) velocities. Author

N78-26101*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

CALCULATION OF SUPERSONIC VISCOUS FLOW OVER DELTA WINGS WITH SHARP SUBSONIC LEADING EDGES

Yvon C. Vigneron (Iowa State Univ., Ames), John V. Rakich, and John C. Tannehill (Iowa State Univ., Ames) Jun. 1978 81 p refs Presented at the AIAA 11th Fluid and Plasma Dynamics Conf., Seattle, 10-12 Jul. 1978

(NASA-TM-78500) Avail: NTIS HC A05/MF A01 CSCL 01A

Two complementary procedures were developed to calculate the viscous supersonic flow over conical shapes at large angles of attack, with application to cones and delta wings. In the first approach the flow is assumed to be conical and the governing equations are solved at a given Reynolds number with a time-marching explicit finite-difference algorithm. In the second method the parabolized Navier-Stokes equations are solved with a space-marching implicit noniterative finite-difference algorithm. This latter approach is not restricted to conical shapes and provides a large improvement in computational efficiency over published methods. Results from the two procedures agree very well with each other and with available experimental data. Author

N78-26102*# Polytechnic Inst. of New York. Dept. of Mechanical and Aerospace Engineering.

SLENDER BODY THEORY PROGRAMMED FOR BODIES WITH ARBITRARY CROSS SECTION

J. Werner and A. R. Krenkel Feb. 1978 77 p refs (Grant NsG-1300)

(NASA-CR-145383; POLY-M/AE-77-17) Avail: NTIS HC A05/MF A01 CSCL 01A

A computer program developed for determining the subsonic pressure, force, and moment coefficients for a fuselage-type body using slender body theory is described. The program is suitable for determining the angle of attack and sideslipping characteristics of such bodies in the linear range where viscous effects are not predominant. Procedures developed which are capable of treating cross sections with corners or regions of large curvature are outlined. J.M.S.

N78-26103*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

SUBSONIC LONGITUDINAL AND LATERAL-DIRECTIONAL STATIC AERODYNAMIC CHARACTERISTICS OF A GENERAL RESEARCH FIGHTER MODEL EMPLOYING A STRAKE-WING CONCEPT

Charles H. Fox, Jr. 1978 142 p refs

(NASA-TM-74071) Avail: NTIS HC A07/MF A01 CSCL 01A

A general research fighter model was tested in the Langley 7 by 10 foot high speed tunnel at a Mach number of 0.3. Strakes with exposed semi-spans of 10 percent, 20 percent, and 30 percent of the wing reference semi-span were tested in combination with wings having leading edge sweep angles of 30, 44, and 60 degrees. The angle of attack range was from -4 degrees to approximately 48 degrees at sideslip angles of 0, -5, and 5 degrees. The data are presented without analysis in order to expedite publication. Author

N78-26104*# National Aeronautics and Space Administration, Washington, D. C.

MEASUREMENT OF THE TURBULENCE INTENSITY BEHIND A TWO-DIMENSIONAL CASCADE AND IN A THREE-STAGE AXIAL BLOWER

R. Kiock Jul. 1978 60 p refs Transl. into ENGLISH of "Messung des Turbulenzgrades hinter einem ebenen Schaufelgitter sowie in einem Dreistufigen Axialgeblaese," Rept. 68/32 Inst. fuer Aerodynamik der DFL, Braunschweig (GermanY), 1968 54 p Transl. by Kanner (Leo) Associates, Redwood City, Calif.

(NASA-TM-75275) Avail: NTIS HC A04/MF A01 CSCL 01A

Turbulence intensity (Tu) measurements were made in two-dimensional and rotating cascades of blades in a low-speed cascade wind tunnel using hot-wire probes as sensors. The local Tu at Re = 1.6x100000 was determined in the wake zone behind a two-dimensional cascade. Then the values were recomputed for a rotating cascade, giving a mean turbulence intensity of 6.5% at 1/10 chord downstream and 2.9% at one chord. Fans were used for measurements on the rotating cascade. Re was equal to 7x100000. Frequency analysis was employed to separate the actual Tu of the entry flow from the effects caused by interaction with the rotor blades, showing that the true Tu increased from a few tenths of a percent to 6.6% in the 1st rotor, and from 7.2 to 9.3% in the 2d rotor. The Tu behind the 3d rotor was equal to 8.9%. Author

N78-26105*# National Aeronautics and Space Administration, Washington, D. C.
MEASUREMENT OF LOW TURBULENCE LEVELS WITH A THERMOANEMOMETER
V. S. Demin, O. V. Morin, N. F. Polyakov, and V. A. Shcherbakov Jun. 1978 11 p refs Transl. into ENGLISH from Izv. Sib. Otd. Akad. Nauk SSSR, Tekh. Nauk (USSR) vol. 8, no. 2, Jun. 1972 p 21-24 Original language document was announced as A73-13666 Transl. by Kanner, (Leo) Associates, Redwood City, Calif.
(Contract NASw-2790)
(NASA-TM-75282) Avail: NTIS HC A02/MF A01 CSCL 01A

The trend for decreasing the drag of aircraft is retention of laminar flow in the boundary layer over a large portion of the surface. The laminar boundary layer was studied in a low turbulence wind tunnel for low subsonic velocities. The method used and results of measurements of very low levels of turbulence are presented. Measurements were performed by a constant-resistance thermoanemometer. M.V.

N78-26106*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
COMPUTATIONAL WING OPTIMIZATION AND COMPARISONS WITH EXPERIMENT FOR A SEMI-SPAN WING MODEL
E. G. Waggoner (Vought Corp., Dallas, Tex.), H. P. Haney (Vought Corp., Dallas, Tex.), and W. F. Ballhaus Jun. 1978 90 p refs (NASA-TM-78480; A-7395; AVRADCOM-TR-78-33(AM)) Avail: NTIS HC A05/MF A01 CSCL 01A

A computational wing optimization procedure was developed and verified by an experimental investigation of a semi-span variable camber wing model in the NASA Ames Research Center 14 foot transonic wind tunnel. The Bailey-Ballhaus transonic potential flow analysis and Woodward-Carmichael linear theory codes were linked to Vanderplaats constrained minimization routine to optimize model configurations at several subsonic and transonic design points. The 35 deg swept wing is characterized by multi-segmented leading and trailing edge flaps whose hinge lines are swept relative to the leading and trailing edges of the wing. By varying deflection angles of the flap segments, camber and twist distribution can be optimized for different design conditions. Results indicate that numerical optimization can be both an effective and efficient design tool. The optimized configurations had as good or better lift to drag ratios at the design points as the best designs previously tested during an extensive parametric study. J.M.S.

N78-26107*# Mississippi State Univ., Mississippi State.
NUMERICAL SOLUTION OF THE NAVIER-STOKES EQUATIONS FOR SUPER-SONIC FLOWS WITH STRONG SHOCKS Ph.D. Thesis
Krishna Devarayalu Aug. 1978 102 p refs
(Grant NsG-1242)
(NASA-CR-157230) Avail: NTIS HC A06/MF A01 CSCL 20D

The numerical solution of the full Navier-Stokes Equations for viscous flows with high Mach numbers and a strong detached bow shock was obtained. Two dimensional flows around a circular cylinder, and a circular cylinder with an aft-body in the form of a fairing, were considered. The solution of the compressible N.S. equations was accomplished by the method of finite differences. An implicit scheme of solution, the S.O.R., was used with the optimum acceleration parameters determined by trial and error. The tensor notation was used in writing the N-S Equations transformed into general curvilinear coordinates. The equations for the generation of the coordinate system were solved, followed by the solution of the N.S. equations, at the end of a set of given number of time steps. 'Wiggles', constituted the one major problem that needed to be overcome. These oscillations give rise to quantities such as negative temperatures, which ultimately caused the computational program to break down. Certain dissipative finite-difference schemes damped these oscillations. L.S.

N78-26108*# McDonnell-Douglas Corp., Long Beach, Calif.
A GEOMETRY PACKAGE FOR GENERATION OF INPUT DATA FOR A THREE-DIMENSIONAL POTENTIAL-FLOW PROGRAM Final Report, 7 May 1976 - 22 Aug. 1977
N. Douglas Halsey and John L. Hess Jun. 1978 68 p refs (Contract NAS1-14402)
(NASA-CR-2962; MDC-J7710) Avail: NTIS HC A04/MF A01 CSCL 01A

The preparation of geometric data for input to three-dimensional potential flow programs was automated and simplified by a geometry package incorporated into the NASA Langley version of the 3-D lifting potential flow program. Input to the computer program for the geometry package consists of a very sparse set of coordinate data, often with an order of magnitude of fewer points than required for the actual potential flow calculations. Isolated components, such as wings, fuselages, etc. are paneled automatically, using one of several possible element distribution algorithms. Curves of intersection between components are calculated, using a hybrid curve-fit/surface-fit approach. Intersecting components are repaneled so that adjacent elements on either side of the intersection curves line up in a satisfactory manner for the potential-flow calculations. Many cases may be run completely (from input, through the geometry package, and through the flow calculations) without interruption. Use of the package significantly reduces the time and expense involved in making three-dimensional potential flow calculations. Author

N78-26109*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EXPERIMENTAL AND ANALYTICAL INVESTIGATION OF A NONAXISYMMETRIC WEDGE NOZZLE AT STATIC CONDITIONS
George T. Carson, Jr. and Mary L. Mason Jul. 1978 45 p refs
(NASA-TP-1188; L-12065) Avail: NTIS HC A03/MF A01 CSCL 01A

An experimental investigation of a nonaxisymmetric wedge nozzle was conducted at static conditions. The resulting data, in the form of detailed pressure distributions and oil flow photographs, expand the current nonaxisymmetric nozzle data base. An analytical investigation has been conducted to evaluate a two-dimensional, inviscid, time-dependent theory as a nonaxisymmetric nozzle performance predictor. For the range of nozzle pressure ratios investigated, results indicate good agreement between theory and experiment in regions of predominately two-dimensional flow and limited agreement in regions of three-dimensional flow. For the wedge nozzle and related nozzle configurations, the two dimensional, inviscid theory may be applied as a limited performance predictor. G.Y.

N78-26110# Naval Postgraduate School, Monterey, Calif.
ANALYSIS OF SUPERSONIC FLOW PAST OSCILLATING CASCADES USING LINEAR AND NONLINEAR METHODS Ph.D. Thesis
Joseph Anthony Strada Sep. 1977 158 p refs
(AD-A053211) Avail: NTIS HC A04/MF A01 CSCL 20/4

This study presents two methods of analysis for the supersonic oscillating cascade with subsonic leading edge. A relatively straightforward solution is developed for the slowly oscillating finite and infinite flat-plate cascades which provides simple analytical expressions for the unsteady pressure distributions. Comparison with other solutions is generally excellent. Some additional linear topics including resonance and a unique inflow condition are also treated. In addition a nonlinear method of characteristics solution for finite cascades is described which permits analysis of blade thickness effects on flutter. At this time, only the inlet and passage flow computations have been completed and are compared with available experimental data.
Author (GRA)

N78-26111# National Aerospace Lab., Amsterdam (Netherlands). Fluid Dynamics Div.
EVALUATION OF A METHOD FOR THE PREDICTON OF JET-AIRFRAME INTERFERENCE
H. Snel 22 Nov. 1976 64 p refs
(Contract NIVR-1761)
(NLR-TR-76132-U) Avail: NTIS HC A04/MF A01

A method developed at NLR for the prediction of interference between (propulsion) jets and parts of airframes is presented. The jet flow region is described by a model for a jet in a non-uniform mainflow, accounting for the presence of the airframe. The potential flow field around the airframe-jet combination is

calculated with a panel method. The location of the jet boundary and the inflow conditions on this surface follow from the jet model. The method is applied to a number of wing-nacelle-jet combinations, which were also studied experimentally. Calculated and measured pressure distribution on the wing were compared in detail, and agreement was found to be good for all configurations. Author (ESA)

N78-26112# Aeronautical Research Inst. of Sweden, Stockholm. Aerodynamics Dept.

MEASUREMENT OF THE PITCH DAMPING ON TWO AGARD B MODELS IN THE FFA S4 AND S5 WIND TUNNELS Final Report

Stig Lundgren 1977 29 p refs

(Contract F-INK-11-12-73208)

(FFA-AU-556) Avail: NTIS HC A03/MF A01

Transonic/supersonic wind tunnel measurements of the pitch damping of two AGARD B models of wing spans 120 mm and 240 mm, respectively, were made using free oscillation techniques. The purpose of the investigation was to measure stability derivatives in pitch of the models and to study interference effects on the pitch damping in the two tunnels. The results of the investigation show a large difference in the pitch damping with and without boundary layer trips on the models. For the larger model the pitch damping in the two tunnels agreed rather well up to M = 0.95, but between M = 0.95 to 1.0 the damping was smaller in the larger tunnel. For the smaller model the agreement in the results from the two tunnels was somewhat less. Comparison of results for models of different sizes in the same tunnel showed discrepancies at near sonic speeds. Rolling angles of 90 deg had no effect on the pitch damping in the larger tunnel, but for the larger model in the smaller tunnel the effect was considerable. Various vertical positions of the models in the tunnels had little effect on the pitch damping.

Author (ESA)

N78-26113# National Aerospace Lab., Amsterdam (Netherlands). Fluid Dynamics Div.

UNSTEADY AIRLOADS ON AN OSCILLATING SUPERCRITICAL AIRFOIL

H. Tijdeman, P. Schippers, and A. J. Persoon 7 Mar. 1977 18 p refs Presented at the AGARD Specialists' Meeting on Unsteady Airloads in Separated and Transonic Flow, Lisbon, 17-22 Apr. 1977 Sponsored by Neth. Agency for Aerospace Programs (NIVR)

(NLR-MP-77008-U) Avail: NTIS HC A02/MF A01

Results are presented of unsteady pressure measurements on a two-dimensional model of the supercritical NLR 7301 airfoil performing pitching oscillations about an axis at 40 per cent of the chord. Author (ESA)

N78-26114# Transport and Road Research Lab., Crowthorne (England). Transport Engineering Div.

WIND TUNNEL TESTS ON SCALE MODELS OF HEAVY GOODS VEHICLES

K. C. Ingram 1977 39 p refs

(PB-277683/9; TRRL-Supplementary-337) Avail: NTIS HC A03/MF A01 CSCL 13F

Wind tunnel tests were carried out to illustrate the more important aerodynamic features of heavy goods vehicles. Basic parameters such as trailer height, tractor-trailer gap size and leading edge radii are discussed, together with the differences between several popular vehicle configurations. GRA

N78-26115# Advisory Group for Aerospace Research and Development, Paris (France).

TECHNICAL EVALUATION REPORT OF THE SPECIALISTS' MEETING ON UNSTEADY AIRLOADS IN SEPARATED AND TRANSONIC FLOW

W. J. Mykytow (AFFDL, Wright-Patterson AFB, Ohio), B. Laschka (Messerchmitt-Boelkow-Blohm GmbH, Munich), and J. J. Olsen (AFFDL, Wright-Patterson AFB, Ohio) Apr. 1978 80 p refs Meeting held in Lisbon, 19-20 Apr. 1977

(AGARD-AR-108; ISBN-92-835-1279-0) Avail: NTIS HC A05/MF A01

The prediction and description of the separated flow environment and the essential effects of airframe response on individual aircraft components are discussed. Flutter, aeroelastic instabilities involving coupling with active control systems and other static and dynamic aeroelastic problems, with specific reference to the transonic speed range, are also presented. For individual titles, see N78-26116 through N78-26118.

N78-26116# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).

AIRFRAME RESPONSE TO SEPARATED FLOW

B. Laschka and W. J. Mykytow (AFFDL, Wright-Patterson AFB, Ohio) *In* AGARD Tech. Evaluation Rept. of the Specialist Meeting on the Unsteady Airloads in Separated and Transonic Flow Apr. 1978 p 3-40 refs (For availability see N78-26115 17-02) Avail: NTIS HC A05/MF A01

The effects of separated or unsteady flow on military aircraft may lead to failures of primary or secondary structures when exceeding design stress limits or design fatigue loads. The separated and unsteady flow environment is described, and its unsteady pressures and forces were determined by wind tunnel and flight test techniques. A description and discussion of the analytical approaches used for the prediction of the essential airframe response effects are given. M.V.

N78-26117# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.

TRANSONIC UNSTEADY AEROELASTIC PHENOMENA

W. J. Mykytow and J. J. Olsen *In* AGARD Tech. Evaluation Rept. of the Specialist Meeting on the Unsteady Airloads in Separated and Transonic Flow Apr. 1978 p 42-76 refs (For availability see N78-26115 17-02)

Avail: NTIS HC A05/MF A01

The development of two dimensional non-viscous methods for predicting unsteady airloads up to M = 0.9 are discussed. Methods and measurements of airloads on an oscillating, thick supercritical airfoil were evaluated. These papers and their references set the state-of-the-art and provide a groundwork for some judgments concerning the development of three dimensional engineering methods, and will help to define standard configurations and parameters to be used in formal and informal joint experimental and analytical programs. M.V.

N78-26118# Advisory Group for Aerospace Research and Development, Paris (France).

COMMENTS ON THE STATE OF THE ART OF TRANSONIC UNSTEADY AERODYNAMICS

H. C. Garner *In its* Tech. Evaluation Rept. of the Specialist Meeting on the Unsteady Airloads in Separated and Transonic Flow Apr. 1978 p 77-78 (For availability see N78-26115 17-02)

Avail: NTIS HC A05/MF A01

A Venn diagram concerning the state-of-the-art with respect to aerodynamic loading on wings in supercritical flow is presented. It was suggested that military applications demand attention to realistic methods for low-supersonic flutter aerodynamics. M.V.

N78-26080# Messerschmidt-Boelkow G.m.b.H., Munich (West Germany). Unternehmensbereich Flugzeuge.

DRAG MEASUREMENT IN TRANSONIC WIND TUNNELS

Felix Awehla *In* AGARD Performance Prediction Methods May 1978 18 p refs (For availability see N78-26074 17-01)

Avail: NTIS HC A16/MF A01

03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

N78-26119*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

NASA AVIATION SAFETY REPORTING SYSTEM

Oct. 1977 87 p Prepared in cooperation with Battelle Columbus Labs., Mountain View, Calif.

(NASA-TM-78433; A-7189; QR-4) Avail: NTIS

HC A05/MF A01 CSCL 01C

A decline in reports concerning small aircraft was noted; more reports involved transport aircraft, professional pilots, instrument meteorological conditions, and weather problems. A study of 136 reports of operational problems in terminal radar service areas was made. Pilot, controller, and system factors were found to be associated with these occurrences. Information transfer difficulties were prominent. Misunderstandings by pilots, and in some cases by controllers, of the policies and limitations of terminal radar programs were observed. G.Y.

N78-26120# SRI International Corp., Arlington, Va.
FORECAST AND ANALYSIS OF INTERNATIONAL AIR TRAFFIC IN RELATION TO TRANSOCEANIC COMMUNICATION REQUIREMENTS Summary Report
Randall Pozdena, James Gorham, Dorothea Gross, and Dennis Yee Dec. 1977 145 p refs
(Contract DOT-FA75WA-3574-1)
(AD-A052840; FAA-RD-77-131) Avail: NTIS HC A07/MF A01 CSCL 01/2

Estimates and forecasts through 1995 of international air traffic and peak Instantaneous Airborne Counts (IACS) are developed in relation to transoceanic communication requirements. Data are presented here for the Atlantic Ocean basin area lying between 10 deg east and 80 deg west longitude and including South American and African continental traffic likely to enter a satellite ATC environment; for the Pacific Ocean basin running from 120 deg west to 120 east longitude; and the Indian Ocean basin running from 120 deg east to 60 deg east longitude. For the Atlantic basin peak basin IACS are forecast to double by 1995 under a low estimate and quadruple under the high estimate. For the Pacific basin they are forecast to more than double under the low estimate and more than quadruple under a high estimate, and for the Indian basin they are forecast to increase over 1 1/2 times under the low estimate and quintruple under the high estimate. Described are future travel demands; institutional and technological market environments in which air traffic and aircraft movements will be generated; models for forecasting air travel; aircraft movements; and counting IACs and how these models are used to develop peak IACs. G.G.

N78-26121# National Transportation Safety Board, Washington, D. C. Bureau of Accident Investigation.
AIRCRAFT ACCIDENT REPORT: ATLANTIC CITY AIRLINES, INC., DEHAVILLAND DHC-6, TWIN OTTER, N101AC, CAPE MAY COUNTY AIRPORT, NEW JERSEY, 12 DECEMBER 1976
23 Nov. 1977 31 p refs
(NTISUB/C/104-012; NTSB-AAR-77-12) Avail: NTIS HC A03/MF A01 CSCL 01B

A DeHavilland DHC-6 Twin Otter, operating as Allegheny Commuter Flight 977, crashed about 4,000 feet short of the approach end of runway 19 at Cape May County Airport. The flight was making a VOR approach to runway 23 with a circle to land on runway 19. Of the 10 persons aboard, 4 died of injuries received in the crash. The aircraft was destroyed. The probable cause of this accident was the flightcrew's lack of altitude awareness during a circling approach which permitted the aircraft's flightpath to deviate below a safe approach profile. The aircraft's rate of descent and descent flightpath angle increased as a result of wind shear encountered during the visual approach below minimum descent altitude. GRA

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Spacecraft Communications, Command, and Tracking* and *32 Communications.*

N78-26122*# Ohio Univ., Athens. Dept. of Electrical Engineering.
A VIDEO DISPLAY INTERFACE FOR THE LORAN-C NAVIGATION RECEIVER DEVELOPMENT SYSTEM
Joseph P. Fischer and Robert W. Lilley May 1978 15 p refs (Grant NGR-36-009-017)
(NASA-CR-156934; TM-58) Avail: NTIS HC A02/MF A01 CSCL 17G

A microprocessor-based development system was designed and fabricated for prototype test of navigation receiver designs. During use of this system in the development of low-cost LORAN-C receiver/processor concepts, the limitations of the integral KIM-1 display were severely felt. It was to augment this numerical display that the video character display was produced. The circuit design presented meets the need for a flexible-format display capable of driving a small standard video monitor with only minimal demands upon microprocessor memory and MPU cycles. L.S.

N78-26123# Federal Aviation Administration, Washington, D. C. Systems Research and Development Service.
DISCRETE ADDRESS BEACON SYSTEM (DABS) DEVELOPMENT TEST AND EVALUATION (DT AND E) PROGRAM Final Report
John J. Wojciech Dec. 1977 28 p refs
(FAA Proj. 034-241)
(AD-A052363; FAA-RD-77-185) Avail: NTIS HC A03/MF A01 CSCL 17/2

The program to accomplish the Development Test and Evaluation (DT&E) of the Discrete Address Beacon System (DABS) is defined. The goals of the DABS DT&E Program are to establish the DABS performance characteristics, determine the compatibility of DABS with the Air Traffic Control (ATC) system, and demonstrate the ATC performance improvements made possible by DABS. The DABS DT&E Program consists of four phases: factory acceptance tests, field acceptance tests, performance tests, and DABS/ATC systems tests. General information is provided on the test requirements associated with each program phase, documentation requirements, organizational responsibilities, and schedules. L.S.

N78-26124# Advisory Group for Aerospace Research and Development, Paris (France).
STRAP-DOWN INERTIAL SYSTEMS
May 1978 276 p refs Partly in ENGLISH and FRENCH Lecture ser. held at London, 6-7 Jun. 1978; Copenhagen, 9 Jun. 1978; Bokesjo, Norway, 12-13 Jun. 1978; Cologne, 15-16 Jun. 1978; Rome, 19-20 1978
Avail: NTIS HC A13/MF A01

A detailed tutorial to strapdown inertial sensors, algorithms and systems is presented. Actual system applications using all of the different types of inertial sensors was emphasized. For individual titles, see N78-26125 through N78-26132.

N78-26125# Draper (Charles Stark) Lab., Inc., Cambridge, Mass. Advanced Systems Dept.
STRAPDOWN INERTIAL SYSTEMS: THEORY AND APPLICATIONS. INTRODUCTION AND OVERVIEW
George T. Schmidt *In* AGARD Strap-Down Inertial Systems May 1978 10 p refs (For availability see N78-26124 17-04)
Avail: NTIS HC A13/MF A01

Comparisons between conventional gimbal inertial systems and strapdown inertial systems are presented in terms of implementation requirements and performance differences. A generalized approach to inertial system analysis that can determine the performance of different inertial mechanizations is described. Author

N78-26126# Honeywell, Inc., Minneapolis, Minn. Avionics Div.
STRAPDOWN SENSORS
Payl G. Savage *In* AGARD Strap-Down Inertial Systems May 1978 46 p refs (For availability see N78-26124 17-04)
Avail: NTIS HC A03/MF A01

Gyros and accelerometers available for strapdown digital system application are described and compared. Instruments described are the following: (1) single degree of freedom floated rate integrating gyro; (2) tuned rotor gyro; (3) electrostatic gyro; (4) laser gyro; and (5) pendulous accelerometer. For each sensor the theory of operation and mechanization approach was studied

and an analytical error model was developed. Performance characteristics were analyzed. Advantages and limitations were examined and application areas were identified. Torque loop electronic design approaches that were utilized with the torque rebalance strapdown sensors were reviewed. B.B.

N78-26127# Lear Siegler, Inc., Grand Rapids, Mich. Instrument Div.

STRAPDOWN SYSTEM ALGORITHMS

Alan VanBronkhorst *In* AGARD Strap-Down Inertial Systems May 1978 22 p refs (For availability see N78-26124 17-04)
Avail: NTIS HC A13/MF A01

Strapdown system algorithms are the mathematical definition of processes which convert the measured outputs of inertial sensors that are fixed to a vehicle body axis into quantities which can be used to control the vehicle. The outputs of body-fixed inertial sensors are angular rates and linear velocities along orthogonal axes. The measured angular rates are converted into changes in attitude of the vehicle with respect to its initial orientation. The resulting attitude transformation matrix is used to convert the measured velocities from body axes to reference coordinates. The essential algorithms are described in terms of analytic equations and procedures for optimizing the critical algorithms. B.B.

N78-26128# Lear Siegler, Inc., Grand Rapids, Mich. Instrument Div.

STRAPDOWN SYSTEM SYNTHESIS

Alan VanBronkhorst *In* AGARD Strap-Down Inertial Systems May 1978 14 p refs (For availability see N78-26124 17-04)
Avail: NTIS HC A13/MF A01

Strapdown system synthesis is the process of developing a cost/performance optimized assembly for application in a particular weapon system. The procedure is a two way process of definition and demonstration. Definition begins with the weapon system requirements and generates the specifications, in a top down process, of the system, subassemblies, and elements. Demonstration begins with the physical elements and their defined specifications and, in a step by step bottom-up integration process, completes the synthesis of the system. The major factors and tasks which characterize the process of strapdown system synthesis are discussed. B.B.

N78-26129# Marconi-Elliott Avionic Systems Ltd., Rochester (England).

APPLICATION OF STRAPDOWN INERTIAL SYSTEMS WITH PARTICULAR REFERENCE TO UNDERWATER VEHICLES

J. R. Catford *In* AGARD Strap-Down Inertial Systems May 1978 17 p (For availability see N78-26124 17-04)
Avail: NTIS HC A13/MF A01

An application of strapdown inertial techniques is presented. The theory of the strapdown attitude sensing mechanization was explained and the experience gained from various trails was illustrated. Digital mechanization of the attitude sensing function is described. A brief examination is made of the way in which the techniques developed for the underwater weapon environment can be extended for other relatively low accuracy strapdown inertial mechanizations. B.B.

N78-26130# Sperry Rand Corp., Great Neck, N. Y. Gyroscope Div.

LASER-GYRO STRAPDOWN INERTIAL SYSTEM APPLICATIONS

Emanuel Levinson *In* AGARD Strap-Down Inertial Systems May 1978 48 p refs (For availability see N78-26124 17-04)
Avail: NTIS HC A13/MF A01

The following laser gyro strapdown inertial systems are described: (1) tactical air to surface missile midcourse guidance; (2) shipboard fire control; attitude reference; and (3) aircraft inertial navigation. Mission requirements system configuration, alignment techniques, and existing hardware and software are delineated for each application. Error analysis simulation and test data are presented which demonstrate the capacity of the laser gyro system to meet the specific application requirements. B.B.

N78-26131# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany). Aircraft Div.

APPLICATION OF STRAPDOWN INERTIAL NAVIGATION TO HIGH PERFORMANCE FIGHTER AIRCRAFT

Wolfgang J. Kubbat *In* AGARD Strap-Down Inertial Systems May 1978 16 p refs (For availability see N78-26124 17-04)
Avail: NTIS HC A13/MF A01

A experimental strapdown inertial navigation system which is part of an integrated guidance and control system was examined. Based upon technical requirements and a general comparison between a gimballed solution vs a strapdown solution, a description of the major elements of the redundant inertial information and computation system was given. The redundant inertial information and computation system was given. The redundancy management problem was addressed as well as software timing and memory occupation. Various aspects of advanced configurations such as sensor skewing and data bus application were also included. B.B.

N78-26132# Societe de Fabrication d'Instruments de Mesure SFIM, Massy (France).

SIL 3 STRAP-DOWN INERTIAL GUIDANCE SYSTEM FOR TACTICAL MISSILES

G.Cattan and J. Michelin *In* AGARD Strap-Down Inertial Systems May 1978 53 p In ENGLISH and FRENCH (For availability see N78-26124 17-04)
Avail: NTIS HC A13/MF A01

A detailed tutorial to strapdown inertial sensors, algorithms and systems is presented. Actual system applications using all of the different types of inertial sensors was emphasized. B.B.

N78-26057# Stuttgart Univ. (West Germany). Inst. Fuer Flugnavigation.

PROPOSAL FOR A COST EFFECTIVE RADAR NAVIGATION SYSTEM FOR LOW ALTITUDE AND TERMINAL AREA FLIGHT

E. Wildermuth *In* AGARD Guidance and Control Design Considerations for Low-Altitude and Terminal-Area Flight Apr. 1978 13 p refs (For availability see N78-26049 17-01)
Avail: NTIS HC A14/MF A01

N78-26062# Royal Aircraft Establishment, Bedford (England). Operational Systems Div.

STEEP GRADIENT APPROACH SYSTEMS RESEARCH FOR ALL-WEATHER OPERATIONS

A. D. Brown *In* AGARD Guidance and Control Design Considerations for Low-Altitude and Terminal-Area Flight Apr. 1978 15 p refs (For availability see N78-26049 17-01)
Avail: NTIS HC A14/MF A01

N78-26066*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

AUTOMATIC FLIGHT PERFORMANCE OF A TRANSPORT AIRPLANE ON COMPLEX MICROWAVE LANDING SYSTEM PATHS

Thomas M. Walsh and Earl F. Weener (Boeing Co., Seattle) *In* AGARD Guidance and Control Design Considerations for Low-Altitude and Terminal-Area Flight Apr. 1978 12 p refs (For availability see N78-26049 17-01)
Avail: NTIS HC A14/MF A01

N78-26067# Centre d'Etudes et de Recherches, Toulouse (France).

ACCURATE TIMING IN LANDINGS THROUGH AIR TRAFFIC CONTROL

Marc Pelegrin and Nicole Imbert *In* AGARD Guidance and Control Design Considerations for Low-Altitude and Terminal-Area Flight Apr. 1978 14 p refs (For availability see N78-26049 17-01)
Avail: NTIS HC A14/MF A01

N78-26068# Army Avionics Research and Development Activity, Fort Monmouth, N. J.

PROPAGATION INTEGRITY FOR MICROWAVE INSTRUMENT LANDING SYSTEMS

Paul S. Demko *In* AGARD Guidance and Control Design Considerations for Low-Altitude and Terminal-Area Flight Apr. 1978 8 p refs (For availability see N78-26049 17-01)
Avail: NTIS HC A14/MF A01

N78-26069# Standard Electrik Lorenz A.G., Stuttgart (West Germany).
DME-BASED SYSTEM FOR ENROUTE/TERMINAL NAVIGATION, ALL-WEATHER LANDING AND AIR TRAFFIC CONTROL
K. D. Eckert *In* AGARD Guidance and Control Design Considerations for Low-Altitude and Terminal-Area Flight Apr. 1978 13 p (For availability see N78-26049 17-01)
Avail: NTIS HC A14/MF A01

N78-26071*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EXPERIMENTAL DETERMINATION OF THE NAVIGATION ERROR OF THE 4-D NAVIGATION, GUIDANCE, AND CONTROL SYSTEMS ON THE NASA B-737 AIRPLANE
Charles E. Knox *In* AGARD Guidance and Control Design Considerations for Low-Altitude and Terminal-Area Flight Apr. 1978 14 p (For availability see N78-26049 17-01)
Avail: NTIS HC A14/MF A01 CSCL 17G

N78-26073# Elektronik-System G.m.b.H., Munich (West Germany).
NAVIGATION SYSTEM ASPECTS OF LOW ALTITUDE FLIGHT
Paul A. Bross *In* AGARD Guidance and Control Design Considerations for Low-Altitude and Terminal-Area Flight Apr. 1978 13 p (For availability see N78-26049 17-01)
Avail: NTIS HC A14/MF A01

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics.*

N78-26133*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
TRAJECTORY MODULE OF THE NASA AMES RESEARCH CENTER AIRCRAFT SYNTHESIS PROGRAM ACSYNT
Michael E. Tauber and John A. Paterson Jul. 1978 73 p refs
(NASA-TM-78497; A-7480) Avail: NTIS HC A04/MF A01 CSCL 01C

A program was developed to calculate trajectories for both military and commercial aircraft for use in the aircraft synthesis program, ACSYNT. The function of the trajectory module was to calculate the changes in the vehicle's flight conditions and weight, as fuel is consumed, during the flying of one or more missions. The trajectory calculations started with a takeoff, followed by up to 12 phases chosen from among the following: climb, cruise, acceleration, combat, loiter, descent, and paths. In addition, a balanced field length was computed. The emphasis was on relatively simple formulations and analytic expressions suitable for rapid computation since a prescribed trajectory had to be calculated many times in the process of converging an aircraft design, or finding an optimum configuration. The trajectory module consists of about 2500 cards and operational on a CDC 7600 computer. G.G.

N78-26134# Royal Aircraft Establishment, Farnborough (England).
COMPILATION OF MEASURES TO INCREASE THE FATIGUE STRENGTH OF AIRCRAFT STRUCTURES
D. Schuetz, J. J. Gerharz, and J. E. Moon, ed. Nov. 1977 81 p refs Transl. into ENGLISH of Rept. TB-126 Lab. fuer Betriebsfestigkeit, Darmstadt, 1975 80 p
(RAE-Lib-Trans-1942; BR62769) Avail: NTIS HC A05/MF A01

This literature survey is orientated to comprehensively inform the designer and to ease the selection of suitable measures for a fatigue critical structural detail. Improvement factors presented should only be used as lead-values. G.G.

N78-26135# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
OPTIMAL MISSILE EVASION M.S. Thesis
Robert L. Smith Dec. 1977 76 p refs
(AD-A053267; AFIT/GA/EE/77-5) Avail: NTIS HC A05/MF A01 CSCL 15/7

The purpose of the study is to formulate a method to determine the control strategies that maximize the probability of survival for an evading aircraft against an air-to-air missile. The missile model developed is a typical infrared missile using proportional navigation steering. The P(k) is modeled as ellipsoidal iso-cost surfaces with a cost value that decays exponentially. The problem terminates when the line-of-sight from the missile to the target aligns on the edge of the missile's fusing cone angle. The algorithm developed employs a second order differential dynamic programming model which optimizes the controls of the evading aircraft. Author (GRA)

N78-26136# AiResearch Mfg. Co., Torrance, Calif.
DESIGN CRITERIA FOR APPLICATION OF MEMBRANE NITROGEN INERTING SYSTEMS TO ARMY AIRCRAFT FUEL TANKS Final Technical Report, Oct. 1976 - Sep. 1977
Scott A. Manatt, Linus B. Buss, and Alfred F. Funk Dec. 1977 76 p
(Contract DAAJ02-76-C-0073; DA Proj. 1F2-62209-AH-76)
(AD-A052869; AIRESEARCH-77-14332; USARTL-TR-77-50)
Avail: NTIS HC A04/MF A01 CSCL 01/3

This report describes a study and development program to evaluate the application of a hollow fiber, permeable-membrane-based inert gas generation fuel tank inerting system to U.S. Army aircraft. The purpose of the system is to reduce the oxygen concentration in aircraft fuel tank ullage to an inert condition to eliminate the vulnerability of this volume to explosion and fire hazards associated with the presence of ignition source from hostile gunfire. Unlike some other fuel tank inerting systems, the inert gas generating system requires no regular resupply of expendables and does not add to the fuel tanks any materials that displace or retain fuel. Feasibility studies of system designs and aircraft penalties were evaluated for U.S. Army AH-1G, AAH, UH-1H, UTTAS, CH-47C, and OV-1D aircraft. Preliminary designs were prepared for systems for the following aircraft: AH-1G, CH-47C, and OV-1D (drop tanks only). The design of a flightworthy system was completed for the AH-1G Cobra helicopter. GRA

N78-26137# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
THE DESIGN AND SIMULATION OF A TAKEOFF STABILIZATION SYSTEM FOR AN AIRCRAFT WITH AN AIR CUSHION LANDING SYSTEM M.S. Thesis
Edward A. Kenney Dec. 1977 119 p refs
(AD-A053220; AFIT/GE/EE/77D-43) Avail: NTIS HC A06/MF A01 CSCL 01/3

The inherent instability in pitch and roll associated with an Air Cushion Landing System (ACLS) aircraft at low airspeeds was investigated, and a means to aid control in pitch and roll was developed. The control system required the use of vertical wing tip thrusters which provided thrust up or down depending on the control signal (similar to space vehicle thrusters). These thrusters could be activated alternately to control roll angle and roll rate with the use of a bang-bang optimal controller. As well, the thrusters would be set forward of the aircraft center of gravity and could be activated in tandem to aid in pitch control. The Jindivik Remotely Piloted Vehicle, an Australian target drone, was fitted with an ACLS and taxi tests showed the instability and need for a stabilization system. Subsequent use of Jindivik wind tunnel and taxi test data served as the basis for the development of the roll/pitch control system presented in this paper. Due to computational problems with the air cushion model of the computer program, the controller designs could not be completely verified; but expected trends in pitch, roll, and yaw control were shown. Author (GRA)

N78-26138# Royal Netherlands Aircraft Factories Fokker, Schiphol-Oost. Dept. CB-SC/SO.
A STATISTICAL TEST OF THE CALCULATED MEAN FATIGUE LIFE USING SERVICE EXPERIENCE
C. A. Hermens Aug. 1977 17 p refs

(FOK-S-144) Avail: NTIS HC A02/MF A01

The calculated mean fatigue life of aircraft structures is discussed. A computer program, developed to carry out the test, was applied to the service experience of the F-27 drag stay bracket. It was shown that the method of Larsson for calculation of the mean life of a lug is reliable. The difference between calculated mean life and mean life derived from service experience is probably due to the fact that the average actual load spectrum in service is less severe than the assumed load spectrum in calculation.
ESA

N78-26139# General Accounting Office, Washington, D. C. Procurement and Systems Acquisition Div.
CAN THE ARMY'S $2.8 BILLION PROGRAM MODERNIZE THE CH-47 HELICOPTER BE IMPROVED Report to Congress
24 Feb. 1978 28 p
(PB-277397/6; PSAD-78-18) Avail: NTIS HC A05/MF A01 CSCL 01C

The Army plans to modernize most of its CH-47 helicopter fleet and purchase new modernized CH-47s to provide medium helicopter capability through the 1990s. If current plans are carried out, awards totaling $2.8 billion will be made without the benefit of prime contractor competition. The Secretary of Defense should determine whether or not competition at the prime contractor level may be carried out for this multibillion dollar program.GRA

N78-26140# General Accounting Office, Washington, D. C. Procurement and Systems Acquisition Div.
STATUS OF THE NAVY'S VERTICAL SHORT TAKEOFF AND LANDING AIRCRAFT Report to Congress
23 Feb. 1978 48 p
(PB-277401/6; PSAD-78-61) Avail: NTIS HC A03/MF A01 CSCL 01C

A vertical short takeoff and landing (VSTOL) aircraft program is reported that could change the complexion of Naval aviation at sea. The program will begin replacing conventional takeoff and landing aircraft with VSTOL aircraft during the 1991 to 2000 time frame. VSTOL decisions affect the Navy's entire sea-based aircraft program. New operational concepts are being explored and technology needs are being assessed for VSTOL. Development costs alone are estimated in the billions. GRA

N78-26051# National Aerospace Lab., Amsterdam (Netherlands).
THE GROUND-ATTACK/PENETRATION MODEL: A MONTE CARLO SIMULATION MODEL TO ASSESS THE SURVIVABILITY AND TO EVALUATE TACTICS FOR LOW-ALTITUDE MILITARY MISSIONS IN AN ENVIRONMENT OF GROUND-BASED AIRDEFENCE SYSTEMS
M. H. W. Bovy *In* AGARD Guidance and Control Design Considerations for Low-Altitude and Terminal-Area Flight Apr. 1978 5 p refs (For availability see N78-26049 17-01)
Avail: NTIS HC A14/MF A01

N78-26052# Technische Universitaet, Brunswick (West Germany).
OPEN-LOOP COMPENSATION OF WIND-SHEAR EFFECTS IN LOW LEVEL FLIGHT
Rudolf Brockhaus and Peter Wuest *In* AGARD Guidance and Control Design Considerations for Low-Altitude and Terminal-Area Flight Apr. 1978 19 p refs (For availability see N78-26049 17-01)
Avail: NTIS HC A14/MF A01

N78-26070# National Aerospace Lab., Amsterdam (Netherlands).
THE ANALYSIS OF OPERATIONAL MISSION EXECUTION: AN ASSESSMENT OF LOW-ALTITUDE PERFORMANCE, NAVIGATION ACCURACY AND WEAPON DELIVERY PERFORMANCE
T. J. Stahlie *In* AGARD Guidance and Control Design Considerations for Low-altitude and Terminal-Area Flight Apr. 1978 10 p (For availability see N78-26049 17-01)
Avail: NTIS HC A14/MF A01

N78-26075# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
PERFORMANCE METHODS FOR AIRCRAFT AND MISSILES
L. Earl Miller and Burtis R. Benson *In* AGARD Performance Prediction Methods May 1978 16 p refs (For availability see N78-26074 17-01)
Avail: NTIS HC A16/MF A01

N78-26076# Technische Hochschule, Darmstadt (West Germany). Fachgebiet Flugtechnik.
A SIMPLE CRITERION TO DISTINGUISH BETWEEN POINT AND INTEGRAL PERFORMANCE PROBLEMS AND ITS USE TO SIMPLIFY FLIGHT PROFILE OPTIMIZATIONS
Bernd Faber *In* AGARD Performance Prediction Methods May 1978 15 p refs (For availability see N78-26074 17-01)
Avail: NTIS HC A16/MF A01

N78-26078# Technische Universitaet, Munich (West Germany). Lehrstuhl fuer Flugmechanik und Flugregelung.
THE ON-BOARD CALCULATION OF OPTIMAL CLIMBING PATHS
Gerhard Bruening and Peter Hahn (Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn, West Ger.) *In* AGARD Performance Prediction Methods May 1978 15 p refs (For availability see N78-26074 17-01)
Avail: NTIS HC A16/MF A01

N78-26081# Royal Aircraft Establishment, Farnborough (England).
PERFORMANCE IMPLICATIONS OF SOME RECENT ADVANCES IN WEAPON CARRIAGE RESEARCH
L. Davies *In* AGARD Performance Prediction Methods May 1978 18 p refs (For availability see N78-26074 17-01)
Avail: NTIS HC A16/MF A01

N78-26082# Hawker Siddeley Aviation Ltd., Kingston upon Thames (England).
VTOL PERFORMANCE ESTIMATION FOR JET LIFT AIRCRAFT
C. M. Milford *In* AGARD Performance Prediction Methods May 1978 10 p refs (For availability see N78-26074 17-01)
Avail: NTIS HC A16/MF A01

N78-26083# Vereinigte Flugtechnische Werke-Fokker G.m.b.H., Bremen (West Germany).
COMPARISON OF ESTIMATED AND FLIGHT DATA FOR ROLLING TAKE-OFF AND TRANSITION OF A VTOL AIRCRAFT
Guenter Kollokowski and Richard Smyth *In* AGARD Performance Prediction Methods May 1978 19 p refs (For availability see N78-26074 17-01)
Avail: NTIS HC A16/MF A01

N78-26084# British Aerospace Aircraft Group, Woodford (England). Manchester Div.
A COMPUTERIZED AIRCRAFT PERFORMANCE SYSTEM
John Richardson *In* AGARD Performance Prediction Methods May 1978 16 p (For availability see N78-26074 17-01)
Avail: NTIS HC A16/MF A01

N78-26085# Avions Marcel Dassault-Breguet Aviation, Saint-Cloud (France). Div. des Etudes Avancees.
PERFORMANCE PREDICTIONS OF MARCELL DASSAULT-BREGUET AVIATION AIRCRAFT [PREVISIONS DES PERFORMANCES AUX AVIONS MARCEL DASSAULT-BREGUET AVIATION]
Pierre Bohn *In* AGARD Performance Prediction Methods May 1978 12 p In FRENCH (For availability see N78-26074 17-01)
Avail: NTIS HC A16/MF A01

N78-26086# National Aerospace Lab., Amsterdam (Netherlands). Performance and Evaluation Dept.
PREDICTION OF OPERATIONAL COMBAT PERFORMANCE
H. Tellegen *In* AGARD Performance Prediction Methods May 1978 7 p (For availability see N78-26074 17-01)
Avail: NTIS HC A16/MF A01

N78-26087# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
ANALYSIS OF ERROR SOURCES IN PREDICTED FLIGHT PERFORMANCE

Michael Lotz and Heribert Friedel *In* AGARD Performance Prediction Methods May 1978 11 p (For availability see N78-26074 17-01)
Avail: NTIS HC A16/MF A01

N78-26088# Office National d'Etudes et de Recherches Aerospatiales, Leclerc (France).
PREDICTION OF AERODYNAMIC CHARACTERISTICS OF AN AIRCRAFT FROM A CORRELATION OF RESULTS ON A CALIBRATION MODEL TESTED IN VARIOUS LARGE TRANSONIC TUNNELS
Ph. Poisson-Quinton and X. Vaucheret *In* AGARD Performance Prediction Methods May 1978 17 p refs In FRENCH; ENGLISH summary (For availability see N78-26074 17-01)
Avail: NTIS HC A16/MF A01

N78-26090# McDonnell Aircraft Co., St. Louis, Mo. Aerodynamics Dept.
FLIGHT TEST VERIFICATION OF F-15 PERFORMANCE PREDICTIONS
J. M. Abercrombie *In* AGARD Performance Prediction Methods May 1978 13 p refs (For availability see N78-26074 17-01)
Avail: NTIS HC A16/MF A01

N78-26091# Northrop Corp., Hawthorne, Calif. Aircraft Group.
YF-17 FULL SCALE MINIMUM DRAG PREDICTION
H. W. Grellmann *In* AGARD Performance Prediction Methods May 1978 12 p (For availability see N78-26074 17-01)
Avail: NTIS HC A16/MF A01

N78-26092# General Dynamics/Fort Worth, Tex.
CORRELATION OF F-16 AERODYNAMICS AND PERFORMANCE PREDICTIONS WITH EARLY FLIGHT TEST RESULTS
T. S. Webb, D. R. Kent, and J. B. Webb *In* AGARD Performance Prediction Methods May 1978 17 p refs (For availability see N78-26074 17-01)
Avail: NTIS HC A16/MF A01

N78-26093# Societe Nationale Industrielle Aerospatiale, Paris (France).
A COMPARISON OF PREDICTIONS OBTAINED FROM WIND TUNNEL TESTS AND THE RESULTS FROM CRUISING FLIGHT (AIRBUS AND CONCORDE) [COMPARISON ENTRE LES PREVISIONS DEDUITES DES ESSAIS EN SOUFLLERIE ET LES RESULTATS DE VOL EN CROISIERE (AIRBUS ET CONCORDE)]
J. Berger *In* AGARD Performance Prediction Methods May 1978 50 p refs In FRENCH (For availability see N78-26074 17-01)
Avail: NTIS HC A16/MF A01

06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography*.

N78-26141# Human Engineering Labs., Aberdeen Proving Ground, Md.
A REVIEW OF THE LITERATURE ON ELECTRO-OPTICAL FLIGHT DISPLAYS Final Report
Andrew T. Buckler Feb. 1978 14 p refs
(AD-A053310; HEL-TM-3-78) Avail: NTIS HC A02/MF A01 CSCL 05/8

This report contains a review of the literature on electro-optical flight displays with special emphasis on rotary-wing aircraft. The primary focus of this review was to find research studies in which different symbology formats were compared experimentally. Research of this type was found to be, for the most part, sorely lacking in literature. However, some valuable work has been done in effort to demonstrate the feasibility of certain specific systems. This work should be taken as a baseline in developing candidate symbology formats to be tested empirically to arrive at an optimal standard for rotary-wing E/O displays.
Author (GRA)

N78-26058# British Aircraft Corp., Preston (England). Military Aircraft Div.
DESIGN CONSIDERATIONS FOR A GROUND AVOIDANCE MONITOR FOR FIGHTER AIRCRAFT
D. A. Whittle *In* AGARD Guidance and Control Design Considerations for Low-Altitude and Terminal-Area Flight Apr. 1978 13 p refs (For availability see N78-26049 17-01)
Avail: NTIS HC A14/MF A01

N78-26060# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
TERRAIN FOLLOWING CRITERIA: THE NEED FOR A CANNON MEASURE
A. F. Barfield *In* AGARD Guidance and Control Design Considerations for Low-Altitude and Terminal-Area Flight Apr. 1978 13 p (For availability see N78-26049 17-01)
Avail: NTIS HC A14/MF A01

N78-26061# Air Force Flight Test Center, Edwards AFB, Calif.
B-1 TERRAIN-FOLLOWING DEVELOPMENT
Charles W. Brinkley, Patrick S. Sharp, and Richard Abrams (Rockwell International, Edwards, Calif.) *In* AGARD Guidance and Control Design Considerations for Low-Altitude and Terminal-Area Flight Apr. 1978 13 p (For availability see N78-26049 17-01)
Avail: NTIS HC A14/MF A01

N78-26063*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va. Flight Research Div.
RECENT FLIGHT TEST RESULTS USING AN ELECTRONIC DISPLAY FORMAT ON THE NASA B-737
Samuel A. Morello *In* AGARD Guidance and Control Design Considerations for Low-Altitude and Terminal-Area Flight Apr. 1978 10 p refs (For availability see N78-26049 17-01)
Avail: NTIS HC A14/MF A01 CSCL 01D

07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and on-board auxiliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels*, and *44 Energy Production and Conversion*.

N78-26142 Stanford Univ., Calif.
MINIMUM TIME ACCELERATION OF AIRCRAFT TURBOFAN ENGINES BY USING AN ALGORITHM BASED ON NONLINEAR PROGRAMMING Ph.D. Thesis
Fred Teren 1978 179 p
Avail: Univ. Microfilms Order No. 78-08855

Minimum time accelerations of aircraft turbofan engines are presented. The calculation of these accelerations is made by using a piecewise-linear engine model, and a new algorithm based on nonlinear programming. Use of this model and algorithm allows such trajectories to be readily calculated on a digital computer with a minimal expenditure of computer time. The new algorithm may be used for solution of optimal control problems which are nonlinear in the state variables, and linear in the control variables. Specifically, the most general problem considered is to minimize a performance index subject to satisfaction of the system dynamic equations, a set of terminal constraints, and path inequality constraints. The performance index, system equations, and path constraints are all linear in the control variables. Dissert. Abstr.

N78-26143*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMBUSTOR CONCEPTS FOR AIRCRAFT GAS TURBINE

LOW-POWER EMISSIONS REDUCTION

E. J. Mularz, C. C. Gleason (G.E. Co., Evandale, Ohio), and W. J. Dodds (G.E. Co., Evandale, Ohio) Jul. 1978 20 p refs Presented at the 14th Propulsion Conf., Las Vegas, Nev., 25-27 Jul. 1978; co-sponsored by the AIAA and the Soc. of Automotive Engr.

(NASA-TM-78875; AVRADCOM-TR-78-23(PL); AIAA-Paper-78-999) Avail: NTIS HC A02/MF A01 CSCL 20E

Several combustor concepts were designed and tested to demonstrate significant reductions in aircraft engine idle pollutant emissions. Each concept used a different approach for pollutant reductions: the hot wall combustor employs a thermal barrier coating and impingement cooled liners; the recuperative cooling combustor preheats the air before entering the combustion chamber; and the catalytic converter combustor is composed of a conventional primary zone followed by a catalytic bed for pollutant cleanup. The designs are discussed in detail and test results are presented for a range of aircraft engine idle conditions. The results indicate that ultralow levels of unburned hydrocarbons and carbon monoxide emissions can be achieved. B.B.

N78-26144*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

END-WALL BOUNDARY LAYER PREDICTION FOR AXIAL COMPRESSORS

Peter M. Sockol 1978 19 p refs Presented at the 11th Fluid and Plasma Dynamics Conf., Seattle, 10-12 Jul. 1978; sponsored by AIAA

(NASA-TM-78928; E-9668) Avail: NTIS HC A02/MF A01 CSCL 21E

An integral boundary layer procedure was developed for the computation of viscous and secondary flows along the annulus walls of an axial compressor. The procedure is an outgrowth and extension of the pitch-averaged methods of Mellor and Horlock. In the present work secondary flow theory is used to develop approximations for the velocity profiles inside a rotating blade row and for the blade force deficit terms in the momentum integral equations. The computer code based on this procedure was iteratively coupled to a quasi-one-dimensional model for the external inviscid flow. Computed results are compared with measurements in a compressor cascade. Author

N78-26145*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

LIQUID-COOLING TECHNOLOGY FOR GAS TURBINES REVIEW AND STATUS

G. James VanFossen, Jr. (Army Res. and Technol. Labs.) and Francis S. Stepka Aug. 1978 14 p refs Proposed for presentation at the 13th Intersoc. Energy Conversion Eng. Conf., San Diego, Calif., 20-25 Aug. 1978; sponsored by the SAE, ACS, AIAA, ASME, IEEE, AICHE, and ANS

(NASA-TM-78906; AVRADCOM-TR-78-26(PL); E-9517-1) Avail: NTIS HC A02/MF A01 CSCL 21E

A review of research related to liquid cooling of gas turbines was conducted and an assessment of the state of the art was made. Various methods of liquid cooling turbines were reviewed. Examples and results with test and demonstrator turbines utilizing these methods along with the advantages and disadvantages of the various methods are discussed. B.B.

N78-26146*# General Electric Co., Cincinnati, Ohio. Material and Process Technology Labs.

LOW COST FABRICATION DEVELOPMENT FOR OXIDE DISPERSION STRENGTHENED ALLOY VANES

R. J. Perkins and P. G. Bailey Jun. 1978 117 p refs (Contract NAS3-3-19710)

(NASA-CR-135373; R78AEG418) Avail: NTIS HC A06/MF A01 CSCL 21E

Viable processes were developed for secondary working of oxide dispersion strengthened (ODS) alloys to near-net shapes (NNS) for aircraft turbine vanes. These processes were shown capable of producing required microstructure and properties for vane applications. Material cost savings of 40 to 50% are projected for the NNS process over the current procedures which involve machining from rectangular bar. Additional machining cost savings are projected. Of three secondary working processes evaluated, directional forging and plate bending were determined to be viable NNS processes for ODS vanes. Directional forging was deemed most applicable to high pressure turbine (HPT) vanes with their large thickness variations while plate bending was determined to be most cost effective for low pressure turbine (LPT) vanes because of their limited thickness variations. Since the F101 LPT vane was selected for study in this program, development of plate bending was carried through to establishment of a preliminary process. Preparation of ODS alloy plate for bending was found to be a straight forward process using currently available bar stock, providing that the capability for reheating between roll passes is available. Advanced ODS-NiCrAl and ODS-FeCrAl alloys were utilized on this program. Workability of all alloys was adequate for directional forging and plate bending, but only the ODS-FeCrAl had adequate workability for shaped preform extrustion. Author

N78-26147*# General Applied Science Labs., Inc., Westbury, N. Y.

EXPERIMENTAL STUDY OF THE EFFECTS OF FLAMEHOLDER GEOMETRY ON EMISSIONS AND PERFORMANCE OF LEAN PREMIXED COMBUSTORS Final Report

Gerald Roffe and K. S. Venkataramani Apr. 1978 89 p refs (Contract NAS3-20603)

(NASA-CR-135424; GASL-TR-249) Avail: NTIS HC A05/MF A01 CSCL 21E

Emissions of NOx, CO, and unburned hydrocarbons (UHC) are reported for a lean premixed propane-air system at inlet conditions of 800K and 1MPa using twelve flameholder designs. The flameholders tested represent six design concepts with two values of blockage for each concept. Data were obtained at reference velocities of 35 m/s, 25 m/s and 20 m/s at combustor stations 10 cm and 30 cm downstream of the flameholders. Flameholder pressure drop was found to be a principal determinant of emissions performance. Designs producing larger pressure drops also produced less NOx, CO, and UHC emissions. The lean stability limit equivalence ratio was found to be approximately 0.35 for all designs. Flashback velocities (axial components in the flameholder passages) varied between 30 m/s and 40 m/s. A perforated plate flameholder was operated with a velocity as low as 23 m/s through the perforations at equivalence ratio 0.7 without producing flashback. Author

N78-26148*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EMITTANCE AND ABSORPTANCE OF NASA CERAMIC THERMAL BARRIER COATING SYSTEM

Curt H. Liebert Jun. 1978 31 p refs Presented in part at the Intern. Conf. on Met. Coatings, San Francisco, 3-7 Apr. 1978; sponsored by the Am. Vacuum Soc.

(NASA-TP-1190; E-9474) Avail: NTIS HC A03/MF A01 CSCL 20E

Spectral emittance measurements were made on a two-layer ceramic thermal barrier coating system consisting of a metal substrate, a NiCrAly bond coating and a yttria-stabilized zirconia ceramic coating. Spectral emittance data were obtained for the coating system at temperatures of 300 to 1590 K, ceramic thickness of zero to 0.076 centimeter, and wavelengths of 0.4 to 14.6 micrometers. The data were transformed into total hemispherical emittance values and correlated with respect to ceramic coating thickness and temperature using multiple regression curve fitting techniques. The results show that the ceramic thermal barrier coating system is highly reflective and significantly reduces radiation heat loads on cooled gas turbine engine components. Calculation of the radiant heat transfer within the nonisothermal, translucent ceramic coating material shows that the gas-side ceramic coating surface temperature can be used in heat transfer analysis of radiation heat loads on the coating system. Author

N78-26149*# Boeing Commercial Airplane Co., Seattle, Wash.

FLIGHT EFFECTS ON NOISE BY THE JT8D ENGINE WITH INVERTED PRIMARY/FAN FLOW AS MEASURED IN THE NASA-AMES 40 BY 80 FOOT WIND TUNNEL

Frank G. Strout Jun. 1978 246 p refs (Contract NAS2-9302)

(NASA-CR-2996) Avail: NTIS HC A11/MF A01 CSCL 21E

A JT8D-17R engine with inverted primary and fan flows was tested under static conditions as well as in the NASA

Ames 40 by 80 Foot Wind Tunnel to determine static and flight noise characteristics, and flow profile of a large scale engine. Test and analysis techniques developed by a previous model and JT8D engine test program were used to determine the in-flight noise. The engine with inverted flow was tested with a conical nozzle and with a plug nozzle, 20 lobe nozzle, and an acoustic shield. Wind tunnel results show that forward velocity causes significant reduction in peak PNL suppression relative to uninverted flow. The loss of EPNL suppression is relatively modest. The in-flight peak PNL suppression of the inverter with conical nozzle was 2.5 PNdb relative to a static value of 5.5 PNdb. The corresponding EPNL suppression was 4.0 EPNdb for flight and 5.0 EPNdb for static operation. The highest in-flight EPNL suppression was 7.5 EPNdb obtained by the inverter with 20 lobe nozzle and acoustic shield. When compared with the JT8D engine with internal mixer, the inverted flow configuration provides more EPNL suppression under both static and flight conditions. A.R.H.

N78-26077# Technische Hogeschool, Delft (Netherlands).
PREDICTION OF OFF-DESIGN PERFORMANCE OF TURBOJET AND TURBOFAN ENGINES
H. Wittenberg *In* AGARD Performance Prediction Methods May 1978 31 p refs (For availability see N78-26074 17-01)
Avail: NTIS HC A16/MF A01

N78-26079*# National Aeronautics and Space Administration, Washington, D. C.
PROPULSION-AIRFRAME INTERACTIONS PREDICTABILITY
Ronald H. Smith *In* AGARD Performance Prediction Methods May 1978 20 p refs (For availability see N78-26074 17-01)
Avail: NTIS HC A16/MF A01

08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

N78-26150# Indian Inst. of Tech., Bombay. Dept. of Electrical Engineering.
OPTIMAL AUTOSTABILIZER FOR A SUPERSONIC FIGHTER AIRCRAFT
V. V. Athani and Y. S. Apte 19 Sep. 1977 20 p refs Backup document for AIAA Synoptic scheduled for publication in Journal of Guidance and Control in Jan.-Feb. 1979
Avail: NTIS HC A02/MF A01

A fourth order model that includes elevator system dynamics was used. The performance index selected contains quadratic terms in state variables but not in the control variable. Consequently, the optimal control law is of bang-bang type. Since initial conditions in the system keep on changing from time to time, the optimal control law ought to be of feedback type. This makes it incumbent to use dynamic programming to derive the optimal control law. A novel method, involving extension of Krotov's numerical technique, was used for solving the resulting Bellman's equation of dynamic programming. The control law obtained contains only a linear combination of the state variables and is thus very simple to implement. Analog computer results show a dramatic reduction in response time from 3 secs for the aircraft without control to 0.5 sec with control. L.S.

N78-26151*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A FLIGHT INVESTIGATION OF THE STABILITY, CONTROL, AND HANDLING QUALITIES OF AN AUGMENTED JET FLAP STOL AIRPLANE
Richard F. Vomaske, Robert C. Innis, Brian E. Swan (Canadian Armed Forces, Ottawa), and Seth W. Grossmith (Canadian Dept. of Transport, Ottawa) Jun. 1978 147 p refs
(NASA-TP-1254; A-7246) Avail: NTIS HC A07/MF A01 CSCL 01C

The stability, control, and handling qualities of an augmented jet flap STOL airplane are presented. The airplane is an extensively modified de Havilland Buffalo military transport. The modified airplane has two fan-jet engines which provide vectorable thrust and compressed air for the augmentor jet flap and Boundary-Layer Control (BLC). The augmentor and BLC air is cross ducted to minimize asymmetric moments produced when one engine is inoperative. The modifications incorporated in the airplane include a Stability Augmentation System (SAS), a powered elevator, and a powered lateral control system. The test gross weight of the airplane was between 165,000 and 209,000 N (37,000 and 47,000 lb). Stability, control, and handling qualities are presented for the airspeed range of 40 to 180 knots. The lateral-directional handling qualities are considered satisfactory for the normal operating range of 65 to 160 knots airspeed when the SAS is functioning. With the SAS inoperative, poor turn coordination and spiral instability are primary deficiencies contributing to marginal handling qualities in the landing approach. The powered elevator control system enhanced the controllability in pitch, particularly in the landing flare and stall recovery. Author

N78-26050# Ministry of Defence, London (England).
GUIDANCE AND CONTROL FOR LOW LEVEL OFFENSIVE AIRCRAFT: A ROYAL AIR FORCE VIEW
G. A. Barnes *In* AGARD Guidance and Control Design Considerations for Low-Altitude and Terminal-Area Flight Apr. 1978 5 p (For availability see N78-26049 17-01)
Avail: NTIS HC A14/MF A01

N78-26053# Royal Aircraft Establishment, Farnborough (England). Flight Systems Dept.
AIRCRAFT RIDE-BUMPINESS AND THE DESIGN OF RIDE-SMOOTHING SYSTEMS
J. C. Jones and D. E. Fry *In* AGARD Guidance and Control Design Considerations for Low-Altitude and Terminal-Area Flight Apr. 1978 12 p refs (For availability see N78-26049 17-01)
Avail: NTIS HC A14/MF A01

N78-26054# Northrop Corp., Hawthorne, Calif. Aircraft Group.
FLIGHT CONTROL SYSTEM DESIGN FOR RIDE QUALITIES OF HIGHLY MANEUVERABLE FIGHTER AIRCRAFT
J. F. Moynes and J. T. Gallagher *In* AGARD Guidance and Control Design Considerations for Low-Altitude and Terminal-Area Flight Apr. 1978 21 p refs (For availability see N78-26049 17-01)
Avail: NTIS HC A14/MF A01

N78-26059# Marconi-Elliott Avionic Systems Ltd., Rochester (England). Flight Control Div.
SYSTEM INTEGRATION AND SAFETY MONITORING TO ACHIEVE INTEGRITY IN LOW ALTITUDE FLIGHT CONTROL SYSTEMS
D. Sweeting *In* AGARD Guidance and Control Design Considerations for Low-Altitude and Terminal-Area Flight Apr. 1978 16 p refs (For availability see N78-26049 17-01)
Avail: NTIS HC A14/MF A01

N78-26065# Analytic Sciences Corp., Reading, Mass.
EVALUATION OF DIGITAL FLIGHT CONTROL DESIGN FOR VTOL APPROACH AND LANDING
Paul W. Berry, John R. Broussard, and Robert F. Stengel (Princeton Univ., N. J.) *In* AGARD Guidance and Control Design Considerations for Low-Altitude and Terminal-Area Flight Apr. 1978 21 p refs (For availability see N78-26049 17-01)
Avail: NTIS HC A14/MF A01

N78-26072# Technische Universitaet, Brunswick (West Germany).
DIRECT LIFT CONTROL FOR FLIGHT PATH CONTROL AND GUST ALLEVIATION
Gunther Shaenzer *In* AGARD Guidance and Control Design Considerations for Low-Altitude and Terminal-Area Flight Apr. 1978 14 p refs (For availability see N78-26049 17-01)
Avail: NTIS HC A14/MF A01

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tube facilities; and engine test blocks.

For related information see also *14 Ground Support Systems and Facilities (Space).*

N78-26152*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

PLANNING FOR AIRPORT ACCESS: AN ANALYSIS OF THE SAN FRANCISCO BAY AREA

Jarir S. Dajani, ed. (Stanford Univ., Calif.), James V. Jucker, ed. (Stanford Univ., Calif.), and J. Lloyd Jones May 1978 300 p refs Stanford-NASA-ASEE Summer Faculty Fellowship Program on Engineering System Design held at Moffett Field, Calif., 1977

(NASA-CP-2044; A-7347) Avail: NTIS HC A13/MF A01 CSCL 09E

A multidisciplinary systems analysis of airport access to the major airports of the San Francisco Bay Area was made. Basically, it was found that there is no major airport access problem. The argument of the report is that commonly perceived airport access problems are either minor inconvenience magnified out of proportion by a combination of the traveler's unreasonable expectations, anxiety over flight departure and lack of information, or not subject to solutions which do not consider the entire urban transit system. Nine specific conclusions and recommendations for improvement are presented and discussed. Author

N78-26153*# Iowa State Univ. of Science and Technology, Ames. Dept. of Mechanical Engineering.

A STUDY OF TEST SECTION CONFIGURATION FOR SHOCK TUBE TESTING OF TRANSONIC AIRFOILS Final Report

William J. Cook Jun. 1978 70 p refs

(Grant NsG-2152; ISU Proj. 1233)

(NASA-CR-157237; ISU-ERI-Ames-78336) Avail: NTIS HC A04/MF A01 CSCL 14B

Two methods are investigated for alleviating wall interference effects in a shock tube test section intended for testing two-dimensional transonic airfoils. The first method involves contouring the test section walls to match approximate streamlines in the flow. Contours are matched to each airfoil tested to produce results close to those obtained in a conventional wind tunnel. Data from a previous study and the present study for two different airfoils demonstrate that useful results are obtained in a shock tube using a test section with contoured walls. The second method involves use of a fixed-geometry slotted-wall test section to provide automatic flow compensation for various airfoils. The slotted-wall test section developed exhibited the desired performance characteristics in the approximate Mach number range 0.82 to 0.89, as evidenced by good agreement obtained between shock tube and wind tunnel results for several airfoil flows. G.G.

N78-26094# Lockheed-California Co., Burbank.

CORRELATION OF WIND-TUNNEL AND FLIGHT-TEST DATA FOR THE LOCKHEED L-1011 TRISTAR AIRPLANE

R. H. Hopps and E. C. B. Danforth *In* AGARD Performance Prediction Methods May 1978 12 p (For availability see N78-26074 17-01)

Avail: NTIS HC A16/MF A01

12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

N78-26154*# General Research Corp., McLean, Va.

SOLAR SAIL-SOLAR ELECTRIC TECHNOLOGY READINESS AND TRANSFER ASSESSMENT Final Report

Ramon L. Chase Aug. 1977 62 p

(Contract NASw-2973)

(NASA-CR-157239; Rept-709-01-CR; WGRC-77-4764) Avail: NTIS HC A04/MF A01 CSCL 22A

A method of conducting a technology readiness assessment was developed. It uses existing OAST technology readiness and risk criteria to define a technology readiness factor that considers both the required gain in technology readiness level to achieved technology readiness plus the degree of effort associated with achieving the gain. The results indicate that Solar Electric Propulsion is preferred based on technology readiness criteria. Both Solar Sail and Solar Electric Propulsion have a high level of transfer potential for future NASA missions, and each has considerable technology spillover for non-NASA applications.

Author

N78-26155*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

LARGE SPACE SYSTEMS TECHNOLOGY, VOLUME 1

E. C. Naumann, comp. and A. Butterfield, comp. 1978 568 p Seminar held at Hampton, Va., 17-19 Jan. 1978 2 Vol.

(NASA-CP-2035-Vol-1) Avail: NTIS HC A24/MF A01 CSCL 22A

Design considerations for large space antennas are discussed along with some of the following relative topics: (1) application of geotruss erectable antenna 1985 - 2000 systems; (2) technology for accurate surface and attitude control of a large spaceborne antenna and microwave system; and (3) inflight optical measurement of antenna surfaces. B.B.

N78-26156*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

LARGE SPACE SYSTEMS TECHNOLOGY, VOLUME 2

E. C. Naumann, comp. and A. Butterfield, comp. 1978 524 p refs Seminar held at Hampton, Va., 17-19 Jan. 1978 2 Vol.

(NASA-CP-2035-Vol-2) Avail: NTIS HC A24/MF A01 CSCL 22A

Technology related to large space platform systems was addressed and some of the following topics are discussed: (1) equipment installation on large area space systems; (2) structural and thermal considerations for the design of large space platform structures; (3) space fabrication and assembly of graphite composite trusses; and (4) large space platform control avionics considerations. B.B.

N78-26157# Committee on Science and Technology (U. S. House).

FUTURE SPACE PROGRAMS

Washington GPO 1978 991 p refs Hearings before Comm. on Sci. and Technol., 95th Congr., 2d Sess., No. 63, 24-26 Jan. 1978

(GPO-24-215) Avail: Comm. on Sci. and Technol.

Testimony delivered and statements submitted in support of a national program for space utilization are presented. Activities discussed include scientific exploration, space industrialization, and human habitation and space settlement. The development of solar power statellites and NASA's role in future space programs are also discussed. A.R.H.

N78-26158*# National Aeronautics and Space Administration, Washington, D. C.

SPACE TECHNOLOGY AND PRODUCTION

S. D. Grishin, L. V. Leskov, and V. V. Savichev Jun. 1978 52 p refs Transl. into ENGLISH from Ser. Kosmonautika, Astronomiya (USSR), no. 4, 1978 64 p Transl. by Scientific Translation Service, Santa Barbara, Calif.

(Contract NASw-2791)

(NASA-TM-75110) Avail: NTIS HC A04/MF A01 CSCL 22A

General characteristics of the current state of space technology and space production are given. Future directions in space production such as the production of metals, optical glass, biomedical preparations, etc., are discussed. L.S.

N78-26159*# Future Systems, Inc., Gaithersburg, Md.

FORECAST OF SPACE SHUTTLE FLIGHT REQUIREMENTS FOR LAUNCH OF COMMERCIAL COMMUNICATIONS SATELLITES

6 Sep. 1977 126 p refs

(NASA Order W-14367)

(NASA-TM-79512) Avail: NTIS HC A07/MF A01 CSCL 22A

The number of communication satellites required over the

next 25 years to support domestic and regional communication systems for telephony, telegraphy and other low speed data; video teleconferencing, new data services, direct TV broadcasting; INTELSAT; and maritime and aeronautical services was estimated to determine the number of space shuttle flights necessary for orbital launching. A.R.H.

N78-26160# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Space Div.
DEFINITION STUDY OF A MULTIDISCIPLINARY EUROPEAN SPACELAB MISSION. FINAL PRESENTATION Spacelab Utilization Programme
Paris ESA 22 Dec. 1977 41 p
(Contract ESA-3103/77-F-WMT(SC))
(ESA-CR(P)-1035) Avail: NTIS HC A03/MF A01

Starting with the outputs of ESA's two multidisciplinary European mission definition studies and the present status of the first mission, assumptions were derived on ESA's Spacelab utilization program through 1983. Besides the European contribution to the first mission FSLP (E-1) it contains two demonstration missions: a dedicated atmospheric payload's mission E-2 in 1982 and a multidisciplinary mission E-3 in 1983. For this baseline program an overall ground operation concept and flow was established, primarily oriented on program cost efficiency and flexibility. Finally, costs were estimated to conduct mission E-3 that also show clearly where cost drivers exist in future mission project execution. Author (ESA)

N78-26161# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Space Div.
DEFINITION STUDY OF A MULTIDISCIPLINARY EUROPEAN SPACELAB MISSION. VOLUME 1: EXECUTIVE SUMMARY Spacelab Utilization Programme
Paris ESA Aug. 1977 61 p Prepared jointly with Engins Matra and VFW-Fokker
(Contract ESA-3103/77-F-WMT(SC))
(ESA-CR(P)-1011-Vol-1) Avail: NTIS HC A04/MF A01

The possible composition of the Spacelab payload for a follow-on mission is discussed. Accommodation aspects of the selected payload/mission option are considereo. Compatibility with the first Spacelab flight systems is analyzed. Ground operations and a schedule analysis are dealt with. ESA

13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbit and launching dynamics.

N78-26162 Stanford Univ., Calif.
A FINE POINTING CONTROL FOR A LARGE SPINNING SPACECRAFT IN EARTH ORBIT Ph.D. Thesis
Horst C. Salzwedel 1978 94 p
Avail: Univ. Microfilms Order No. 78-08838

A large spinning spacecraft in earth orbit includes a rigidly-mounted telescope, parallel to the spacecraft's intended spin-axis. The three principal moments-of-inertia are unequal. Electric thrustors are used to overcome the gravity-gradient torque components. Uncertainty of the spacecraft's inertia tensor, including misalignment of the telescope axis from the actual principal direction, as well as magnetic, solar pressure and aerodynamic forces, produce disturbing torques which are constant or vary sinusoidally during a spin-rotation. The constant torques and the coefficients of the sinusoidal torques are modeled as first order Markov processes and, consequently, increase the dimension of the dynamical state. Dissert. Abstr.

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, mobile transporters; and simulators.

For related information see also *09 Research Support Facilities (Air)*.

No abstracts in this category.

15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; manned orbital laboratories; reusable vehicles; and space stations.

N78-26163 Texas Univ. at Austin.
ON GRAVITATIONAL RESONANCE AS APPLIED TO THE SYNCHRONOUS SATELLITES Ph.D. Thesis
Donald Dilworth Brand, Jr. 1977 346 p
Avail: Univ. Microfilms Order No. 78-07268

An analytical and numerical analysis of the motion of geosynchronous satellites is presented. Only those satellites with near-equatorial and near-circular orbits are considered. The perturbations taken into account are the earth's oblateness, long-periodic lunisolar effects and the significant longitudinally dependent terms of the geopotential. To accomplish this, a complete first-order canonical resonance solution of a one-degree-of-freedom Hamiltonian is derived under general assumptions using the Bohlin-von Zeipel method. Necessary conditions for the validity of the solution are derived and third-order terms of the Hamiltonian are included in the solution since they are necessary for a complete first-order solution. The solution is in a very simple form and is valid in both the libration and circulation regions of deep resonance without modifications. Mean initial conditions are determined without the occurrence of singularities. Two methods of extending the solution to higher orders are indicated. Dissert. Abstr.

N78-26164 Texas Univ. at Austin.
ADAPTIVE ESTIMATION OF ATMOSPHERIC DRAG ON NEAR EARTH SATELLITES Ph.D. Thesis
Douglas Loel Dowd 1977 279 p
Avail: Univ. Microfilms Order No. 7807288

The application of the linear sequential filter to topocentric observations of near earth satellites whose motions are influenced by uncertain atmospheric drag was studied. The consequence of errors in the drag model, filter divergence, is discussed and demonstrated. The errors in the relative velocity are assumed to be due entirely to errors in the inertial satellite velocity which is estimated as part of the filter state vector. A method for adapting a static atmospheric density profile to reflect the sensed dynamic density profile and thereby reduce the errors in the density model and the satellite state was developed and verified with computer simulations. The difficulties in separating the density and ballistic coefficient in the filter are discussed in view of the observability criterion for the batch filter and the inseparability of the scaling factors of the density and ballistic coefficient was demonstrated with the sequential filter. Dissert. Abstr.

N78-26165*# Atlantic Science Corp., Indialantic, Fla.
IONOSPHERIC RANGE-RATE EFFECTS IN SATELLITE-TO-SATELLITE TRACKING
J. R. Lipofsky, R. B. Bent, S. K. Llewellyn, and P. E. Schmid Nov. 1977 86 p refs
(Contract NAS5-23899)
(NASA-CR-156768) Avail: NTIS HC A05/MF A01 CSCL 22A

Investigation of ionospheric range and range-rate corrections in satellite-to-satellite tracking were investigated. Major problems were cited and the magnitude of errors that have to be consid- ed

for communications between satellites and related experiments was defined. The results point to the need of using a sophisticated modeling approach incorporating daily solar data, and where possible actual ionospheric measurements as update information, as a simple median model cannot possibly account for the complex interaction of the many variables. The findings provide a basis from which the residual errors can be estimated after ionospheric modeling is incorporated in the reduction. Simulations were performed for satellites at various heights: Apollo, Geos, and Nimbus tracked by ATS-6; and in two different geometric configurations: coplanar and perpendicular orbits. Author

N78-26166*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PRELIMINARY CONCEPT, SPECIFICATIONS, AND REQUIREMENTS FOR A ZERO-GRAVITY COMBUSTION FACILITY FOR SPACELAB
Richard L. DeWitt Jun. 1978 51 p refs
(NASA-TM-78910; E-9645) Avail: NTIS HC A04/MF A01 CSCL 22B

The preliminary concept, specifications, and requirements of a reusable zero gravity combustion facility (0-GCF) for use by experimenters aboard the spacelab payload of the space transportation system (STS) orbiter are described. The facility will be amenable to any mission of the STS orbiter in which a spacelab habitable segment and pallet segment are integral and for which orbital mission plans specify induced accelerations of 0.0001 g or less for sufficiently long periods so as not to impact experiment performance. Author

N78-26167*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LONG RANGE ORBITAL ERROR ESTIMATION FOR APPLICATIONS SATELLITES
N. L. Bonavito and J. C. Foreman (Systems and Applied Sciences Corp., Riverdale, Md.) Jan. 1978 18 p refs Submitted for publication
(NASA-TM-78076) Avail: NTIS HC A02/MF A01 CSCL 22A

A method of optimum orbital averaging was employed to study the long range accuracy potential of polar orbiting applications satellites. This approach involved the determination of the boundary conditions of one set of differential equations of motion by adjusting the initial conditions in a least square sense with the use of data generated by another set of differential equations of motion. G.G.

N78-26168# Centre National d'Etudes Spatiales, Toulouse (France).
AERODYNAMICS OF ARIANE LAUNCH VEHICLE [L'AERODYNAMIQUE DU LANCEUR ARIANE]
J. Bouchet and R. Bec Aug. 1977 49 p In FRENCH; ENGLISH summary
(CNES-NT-75) Avail: NTIS HC A03/MF A01

The basic aerodynamic studies of the Ariane launcher and their impact on the course of the experiments are presented emphasizing the relationship between the aerodynamic analysis and a launch vehicle project. The main test results and an analysis of their implications on the design and performance of the vehicle are reviewed. Some aerodynamic phenomena of special relevance to a launch vehicle, the experimental study of which, in the Ariane context, involved the use of new techniques, are also described. Author (ESA)

N78-26089# Naval Air Systems Command, Washington, D. C.
DEVELOPMENT OF TECHNIQUES AND CORRELATION OF RESULTS TO ACCURATELY ESTABLISH THE LIFT/DRAG CHARACTERISTICS OF AN AIR BREATHING MISSILE FROM ANALYTICAL PREDICTIONS, SUB-SCALE AND FULL SCALE WIND TUNNEL TESTS AND FLIGHT TESTS
E. C. Rooney and R. E. Craig (General Dyn./Convair, San Diego, Calif.) *In* AGARD Performance Prediction Methods May 1978 18 p refs (For availability see N78-26074 17-01)
Avail: NTIS HC A16/MF A01

16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation e.g., shuttle operations; and rescue techniques.

For related information see also *03 Air Transportation and Safety* and *85 Urban Technology and Transportation.*

No abstracts in this category.

17 SPACECRAFT COMMUNICATIONS, COMMAND AND TRACKING

Includes telemetry; space communications networks; astronavigation; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications.*

No abstracts in this category.

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes spacecraft thermal and environmental control; and attitude control.

For life support systems see *54 Man/System Technology and Life Support.* For related information see also *05 Aircraft Design, Testing and Performance* and *39 Structural Mechanics.*

N78-26169# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
THE EFFECTS OF STRUCTURAL FLEXIBILITY ON THE NONLINEAR ATTITUDE CONTROL OF SPACECRAFT
Tarek M. M. Abdel-Rahman Dec. 1977 280 p refs
(UTIAS-222; CN-ISSN-0082-5255) Avail: NTIS HC A13/MF A01

The effect of structural flexibility on nonlinear attitude control of flexible spacecraft was investigated. A concise review of possible techniques was carried out. A Lyapunov-like approach for studying stability or dissipativity of pulse output systems was investigated. A quadratic Lyapunov function was considered for studying the discrete transformation of the state variables between two consecutive control pulses. The geometrical properties of the function and of the control system switching relations were used to derive sufficient conditions for asymptotic stability or dissipativity. A known method for simple limit cycles was generalized for the exact determination of complex limit cycles. A suitable method for studying the stability of these limit cycles was selected and summarized. Thus, while the Lyapunov-like results relate to the controller's ability to effect capture to eliminate large initial attitude excursions and bring the pointing error close to the deadband, the limit cycle analysis relates to the normal operation at or near the deadband. B.B.

N78-26170# National Aerospace Lab., Amsterdam (Netherlands).
ATTITUDE RECONSTITUTION OF A SPINNING SPACECRAFT EQUIPPED WITH THE ESA STARMAPPER
P. T. L. M. VanWoerkom and C. R. Traas 30 Aug. 1977 9 p refs Presented at the ESA Conf. on Attitude and Orbit Control Systems, Noordwijk, Neth., 3-6 Oct. 1977
(NLR-MP-77027-U) Avail: NTIS HC A02/MF A01

The ESA starmapper is an optical-electronic instrument, attached to a spinning spacecraft, and equipped with eight slits, each marking the times of passage of stars. The telemetered times of passage are fed into a linear, recursive, minimum variance, extended, square root, adaptive filter in order to obtain an accurate

reconstitution of the spacecraft attitude and system parameters. A brief outline is presented of the mathematical modelling of spacecraft spin dynamics and the starmapper, and of the formulation of the filter. Computer simulations were carried out to investigate how accurately spacecraft attitude and certain spacecraft parameters could be reconstituted from given simulated star passage times. The simulations indicate the usefulness of the square root formulation of the filter, and of its adaptive mechanism. For small nutation angles of the spinning spacecraft, the attitude motion can be reconstituted with an accuracy of about one arcminute. As the nutation angle increases, this accuracy decreases and divergence may result. Author (ESA)

19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography*.

N78-26171# Laboratorio di Ricerca e Technologia per lo Studio del Plasma nello Spazio, Frascati (Italy).
ON THE DETERMINATION OF ZERO LEVEL PARAMETERS FOR A TRIAXIAL FLUXGATE MAGNETOMETER ON HELIOS 1 AND 2 SPACECRAFT
U. Villante (L'Aquila Univ., Italy) and F. Mariani Nov. 1977 14 p refs
(LPS-77-23) Avail: NTIS HC A02/MF A01

Determination of the zero offsets of a spinning triaxial magnetic sensor during flight of the solar probes Helios 1 and 2 is discussed. The demodulation to an orthogonal fixed reference system was made taking into account the effects due to the misalignment of the sensors (which in general are not exactly perpendicular to each other). Some considerations are made for the case of a not-magnetically clean spacecraft. Author (ESA)

20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components e.g., rocket engines; and spacecraft auxiliary power sources.

For related information see also *07 Aircraft Propulsion, 28 Propellants and Fuels*, and *44 Energy Production and Conversion*.

N78-26172*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ION PROPULSION FOR SPACECRAFT
W. R. Kerslake et al 1977 27 p refs
(NASA-TM-79502) Avail: NTIS HC A03/MF A01 CSCL 21C

The theory of the ion-thruster propulsion system is discussed along with the Space Electric Rocket Test 1 and 2. The use of electric propulsion for stationkeeping and attitude control functions of geosynchronous satellites is described, and a comparison of thruster systems is presented. F.O.S.

N78-26173*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INVESTIGATION OF THE EFFECT OF CERAMIC COATINGS ON ROCKET THRUST CHAMBER LIFE
R. J. Quentmeyer, H. J. Kasper, and J. M. Kazaroff 1978 26 p refs Presented at the 14th Propulsion Conf., Las Vegas, Nev., 25-27 Jul. 1978; sponsored by AIAA and the Soc. of Automotive Engr.
(NASA-TM-78892; E-9630; AIAA-Paper-78-1034) Avail: NTIS HC A03/MF A01 CSCL 21H

Cylindrical rocket thrust chamber cylinders were coated with a 0.203 mm (0.008 in.) layer of zirconium oxide using a process that employed electrodeposition of metal to a spray coated mandrel. The cylinders were cyclically tested using hydrogen oxygen propellants at a nominal chamber pressure of 4.14 MN/sq m (600 psia) to show the effect of the coating on life. Both cylinders failed prematurely due to causes unrelated to the coatings. Post destructive analysis showed no cooling passage wall deformation. Where erosion of the coating occurred, the coating thickness stabilized at 0.061 mm (0.0024 in.) within 80 cycles and remained well adhered throughout the tests. Author

N78-26861*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MAGNETOPLASMADYNAMIC THRUSTER APPLICATIONS
E. V. Pawlik *In* Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 211-216 refs (For availability see N78-26837 17-70)
(Contract NAS7-100)
Avail: NTIS HC A13/MF A01 CSCL 21C

N78-26862*# Princeton Univ., N. J.
MINI-CAVITY PLASMA CORE REACTORS FOR DUAL-MODE SPACE NUCLEAR POWER/PROPULSION SYSTEMS M.S. Thesis
Stanley Chow *In its* Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 217-223 refs (For availability see N78-26837 17-70)
(Grant NGR-31-001-328)
Avail: NTIS HC A13/MF A01 CSCL 21F

23 CHEMISTRY AND MATERIALS (GENERAL)

Includes biochemistry and organic chemistry.

N78-26174# Illinois Univ., Urbana-Champaign. Roger Adams Lab.
CHEMISTRY OF THE 1, 2-DIOXETANE RING SYSTEM: CHEMILUMINESCENCE, FRAGMENTATIONS, AND CATALYZED REARRANGEMENTS Technical Report, Jan. 1975 - Dec. 1977
Keith A. Horn, Steven P. Schmidt, Ja-Young Koo, and Gary B. Schuster 18 Apr. 1978 41 p refs
(Contract N00014-76-C-0745)
(AD-A053290; TR-13) Avail: NTIS HC A03/MF A01 CSCL 07/3

The chemistry of the 1.2 dioxetane ring system that has been reported during the past three years is reviewed. Special emphasis is placed on those aspects that deal with the thermal generation of electronically excited states and chemiluminescence. Author (GRA)

N78-26175# Northwestern Univ., Evanston, Ill.
MATERIALS RESEARCH Annual Report, 1 Jul. 1976 - 30 Jun. 1977
Aug. 1977 114 p refs Sponsored in part by ARPA, AFOSR, DOE, NATO, ONR, and AROD
(Grant NSF DMR-76-01057)
(AD-A053181; AR-18) Avail: NTIS HC A06/MF A01 CSCL 05/1

The Eighteenth Annual Technical Report of the Materials Research Center of Northwestern University includes the abstracts of publications and theses which describe the results of materials research conducted during the period 1 July 1976 to 30 June 1977. The research is described in two sections: (1) Thrust Area Research and (2) General Materials Research. The Thrust Area Research has four components: Charge Transport and Electronic Structure; Fatigue of Metals and Alloys; Metals, Alloys and Intermetallic Compounds; and Polymer Processing and Properties. Within each Thrust Area the research supported under the MRL program is presented along with the allied thrust research supported by the agencies indicated. In a number of instances, Center members are active in several areas of endeavor, and their contributions appear in different sections. The General Materials Research section includes: (1) the MRL supported collaborative research of several faculty as well as the individual research projects supported under the MRL program and (2) the non-MRL individually funded research projects. A summary highlighting the principle accomplishments for the Thrust Area Research groups and General Materials Research precedes the listing of the individual items in this report. GRA

N78-26176# Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics.

DEVELOPMENT OF METHODS FOR DETERMINING ORGANIC FREE RADICAL STRUCTURES BY ELECTRON SPIN RESONANCE AND APPLICATION TO THE RADIATION CHEMISTRY OF NUCLEI ACID MODEL COMPOUNDS Ph.D. Thesis

G. W. Fouse, Jr. 1977 199 p refs
(Contract EY-76-C-02-3490)
(UR/3490/LCP-6) Avail: NTIS HC A09/MF A01

A technique was developed for the rapid calculation of single crystal ESR line positions and intensities. This method, was incorporated into a computer program for determining ESR parameters by the least-squares fitting of digitized ESR spectra. A method was developed for the estimation of variance and covariance of eigenvectors and eigenvalues of experimentally-determined tensors. This error analysis is quite general, and may be applied to any tensors which can be determined by the non-linear least-squares fitting of ESR data. Monte-Carlo simulations were employed to estimate the limitations of the approximation method. A generalized method for the calculation of theoretically-expected hyperfine coupling tensors for arbitrary radical models was developed. ERA

24 COMPOSITE MATERIALS

Includes laminates.

N78-26177*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

THE FRICTION AND WEAR PROPERTIES OF SPUTTERED HARD REFRACTORY COMPOUNDS

William A. Brainard Aug. 1978 17 p refs Proposed for presentation at the 2d Intern. Conf. on Solid Lubrication, Denver, 14-18 Aug. 1978; sponsored by the Am. Soc. of Lub. Engr.
(NASA-TM-78895; E-9368) Avail: NTIS HC A02/MF A01 CSCL 11D

Several refractory silicide, boride, and carbide coatings were examined. The coatings were applied to type 440C steel surfaces by radio-frequency sputtering. The friction and wear properties of the coatings were found to be related to stoichiometry and impurity content of the bulk coating as well as the degree of interfacial adherence between coating and substrate. Bulk coating stoichiometry could to a large extent be controlled by the application of a negative bias voltage during deposition. Adherence was promoted by the formation of an oxidized layer at the interface. Deliberate preoxidizing of the 440C produced enhanced adherence for many compounds which are related to the formation of a mixed oxide transition region. Author

N78-26178*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

FRICTION AND WEAR OF CARBON-GRAPHITE MATERIALS FOR HIGH-ENERGY BRAKES

Robert C. Bill Aug. 1978 21 p refs Proposed for presentation at the 2d Intern. Conf. on Solid Lubrication, Denver, 14-18 Aug. 1978; sponsored by the Am. Soc. of Lubrication Engr.
(NASA-TM-78904; AVRADCOM-TR-78-27(PL); E-8259-1) Avail: NTIS HC A02/MF A01 CSCL 11D

Caliper type brake simulation experiments were conducted on seven different carbon graphite materials formulations against a steel disk material and against a carbon graphite disk material. The effects of binder level, boron carbide (B4C) additions, SiC additions, graphite fiber additions, and graphite cloth reinforcement on friction and wear behavior were investigated. Reductions in binder level, additions of B4C, and additions of SiC each resulted in increased wear. The wear rate was not affected by the addition of graphite fibers. Transition to severe wear and high friction was observed in the case of graphite-cloth-reinforced carbon sliding against a disk of similar composition. The transition was related to the disruption of a continuous graphite shear film that must form on the sliding surfaces if low wear is to occur. B.B.

N78-26179# Royal Netherlands Aircraft Factories Fokker, Schiphol-Oost. Dept. CB-SC/SO.

FAILURE AND FATIGUE OF CARBON FIBRE-EPOXY COMPOSITES

P. Minderhoud Jul. 1977 69 p refs
(FOK-S-146) Avail: NTIS HC A04/MF A01

The influence of localized damage on the behavior of carbon fiber epoxy composites was investigated. Various failure mechanisms are discussed. The behavior of multidirectional laminates is described with emphasis on the influence of damage zones due to material weakness on the stress-strain relations and on ultimate failure. The behavior of notched laminates under static loading as well as under fatigue loading was examined. It was demonstrated by observing material damage at a microscale that all these different problems may be related. ESA

N78-26180# National Technical Information Service, Springfield, Va.

ABLATION AND ABLATIVE MATERIALS. VOLUME 1: A BIBLIOGRAPHY WITH ABSTRACTS Progress Report, Jul. 1971 - 1976

Mona F. Smith Mar. 1978 236 p
(NTIS/PS-78/0312/5) Avail: NTIS HC $28.00/MF $28.00 CSCL 11D

Ablation and the properties of the ablative materials are covered in these Federally-funded research reports. Some of the materials cited are silicone rubber, plastic composites, glass reinforced and very low density elastomers, carbon and graphite, refractories, polycarbonates, aluminum, zinc titanate, epoxide resins, and borides. Discussions include ablative flow in gaps and slots, low cost and reusable heat shields, thermochemical reactions and erosion, cross hatching, water fillable polymers, proton activation, and combustion kinetics. Equipment is described, such as nosetip recession sensors, ablation gages, and testing apparatus. Computer programs, space shuttle engineering, space simulation, mathematical analysis, spectrometry, model tests of geometric forms, and high energy flow are included. (this updated bibliography contains 231 abstracts, none of which are new entries to the previous edition.) GRA

N78-26181# National Technical Information Service, Springfield, Va.

ABLATION AND ABLATIVE MATERIALS. VOLUME 2. A BIBLIOGRAPHY WITH ABSTRACTS Progress Report, 1977 - Mar. 1978

Mona F. Smith Mar. 1978 123 p Supersedes NTIS/PS-77/0282; NTIS/PS-76/0216; NTIS/PS-75/212
(NTIS/PS-78/0313/3; NTIS/PS-77/0282; NTIS/PS-76/0216; NTIS/PS-75/212) Avail: NTIS HC $28.00/MF $28.00 CSCL 11D

Ablation and the properties and performance of ablative materials are covered in this bibliography. Among the materials cited are pyrolytic graphite, silicon dioxide, carbon-carbon composites, reinforced plastics, epoxy resins, and refractories. Studies include ablative flow, aerodynamic heating, erosion, and combustion. Equipment discussed in these citations are rocket nozzles, nosetips, reentry vehicles, heat shields, shock tubes, and combustion chambers. Computer programs, spacecraft design, space simulation, mathematical models, and test methods are included. (This updated bibliography contains 118 abstracts, 68 of which are new entries to the previous edition.) GRA

N78-26320# General Motors Research Labs., Warren, Mich.

STIRLING THERMAL ENGINE REGENERATOR COST REDUCTION PROGRAM REPORT 1: WIRE CLOTH MATRIX MATERIALS

John C. Steiner *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 6: Regenerators Apr. 1978 10 p (For availability see N78-26318 17-31)
(GMR-2690-Sect-6.002) Avail: NTIS HC A06/MF A01

25 INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics.*

N78-26182 Stanford Univ., Calif.
EXPERIMENTAL STUDY OF NITRIC OXIDE FORMATION KINETICS Ph.D. Thesis
Jamie Peter Monat 1978 184 p
Avail: Univ. Microfilms Order No. 7808814

The rate coefficient for the reaction N2 + O yields NO + N was measured in the temperature range 2384 - 3850 K using a shock tube technique. Test gas mixtures consisting of N2, O2, N2O, and Kr were heated by incident shock waves and the concentration of NO in the post-shock region was monitored using two independent spectroscopic techniques: IR emission at 5.3 microns, and absorption of CO laser radiation at 5.17 microns. The rate coefficient k sub 1 was determined by comparing experimental and calculated NO profiles using a computer simulation in which k sub 1 was an adjustable parameter. The results of 20 experiments indicate that k sub 1 = 1.84 times 10 to the 14th power exp(-76,250/RT) cu cm/mol with an uncertainty of approximately + or - 35% at the 95% confidence level in the temperature range investigated. The practicality and usefulness of the laser absorption technique for making time-resolved species concentration and vibrational population measurements in high temperature gases was clearly established. Dissert. Abstr.

N78-26183 Stanford Univ., Calif.
ELECTRODEPOSITION OF SOME METALS AND NIOBIUM SUPERCONDUCTING ALLOYS FROM MOLTEN FLUORIDES Ph.D. Thesis
Uri Kohen 1978 299 p
Avail: Univ. Microfilms Order No. 7808773

The major goal of this thesis was to study the feasibility of electrodeposition from molten fluorides of the pure elements niobium, aluminum, tin, germanium and silicon, and the niobium superconducting intermetallic compunds with these elements, and to prepare and study films of these materials in the form of coherent and uniform coatings. Co-deposition of niobium-tin alloys was demonstrated. Of the four intermetallic compounds of the niobium-germanium system, three were obtained as single-phase coatings. Silicon electrocrystallization epitaxy (ECE) was demonstrated for the first time. Dissert. Abstr.

N78-26184*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Chemistry
A FUNDAMENTAL APPROACH TO ADHESION: SYNTHESIS, SURFACE ANALYSIS, THERMODYNAMICS AND MECHANICS Final Report
Wen Chen, David W. Dwight, and James P. Wightman Feb. 1978 143 p refs
(Grant NsG-1124)
(NASA-CR-157228) Avail: NTIS HC A07/MF A01 CSCL 07D

Various surface preparations for titanium 6-4 alloy were studied. An anodizing method was investigated, and compared with the results of other chemical treatments, namely, phosphate/fluoride, Pasa-Jell and Turco. The relative durability of the different surface treatments was assessed by monitoring changes in surface chemistry and morphology occasioned by aging at 505 K (450 F). Basic electron spectroscopic data were collected for polyimide and polyphenylquinoxaline adhesives and synthetic precursors. Fractographic studies were completed for several combinations of adherend, adhesive, and testing conditions. A.R.H.

N78-26185*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
APPLICATION OF ESCA TO THE DETERMINATION OF STOICHIOMETRY IN SPUTTERED COATINGS AND INTERFACE REGIONS
Donald R. Wheeler Aug. 1978 15 p refs Proposed for presentation at the 2d Intern. Conf. on Solid Lubrication, Denver, 14-18 Aug. 1978; sponsored by the Am. Soc. of Lubrication Engr.
(NASA-TM-78896; E-9367) Avail: NTIS HC A02/MF A01 CSCL 07D

X-ray photoelectron spectroscopy was used to characterize radiofrequency sputter deposited films of several refractory compounds. Both the bulk film properties such as purity and stoichiometry and the character of the interfacial region between the film and substrate were examined. The materials were CrB2, MoS2, Mo2C, and Mo2B5 deposited on 440C steel. It was found that oxygen from the sputtering target was the primary impurity in all cases. Biasing improves the film purity. The effect of biasing on film stoichiometry is different for each compound. Comparison of the interfacial composition with friction data suggests that adhesion of these films is improved if a region of mixed film and iron oxides can be formed. Author

N78-26186# Arkansas Univ. at Little Rock.
AN INVESTIGATION OF USING DERIVATION REACTION GAS CHROMATOGRAPHY TO MEASURE ANIONIC WATER QUALITY PARAMETERS Progress Report, 1 Jul. 1974 - 30 Jun. 1977
Richard H. Hanson 30 Jun. 1977 36 p refs
(Contract DI-14-34-0001-6004)
(PB-277471/9; PUB-52; W78-03961; OWRT-B-049-ARK(1)) Avail: NTIS HC A03/MF A01 CSCL 07D

A new analytical method has been developed to measure orthophosphate content in aqueous samples. The reaction gas chromatographic system was capable of analyzing orthophosphate in the range from 0.25 - 5.0 micrograms of P in 50 microliters of aqueous sample. Flame ionization was the most successful detector. The primary advantage of this technique is the small volume of sample required. GRA

N78-26187# California Univ., Berkeley. Lawrence Berkeley Lab.
VISCOSITY OF AQUEOUS SODIUM CHLORIDE SOLUTIONS FROM 0 TO 150 DEG C
H. Ozbek, J. A. Fair, and S. L. Phillips Dec. 1977 65 p refs Presented at the Am. Chem. Soc. 29th Southeast Regional Meeting, Tampa, Fla., 9-11 Nov. 1977
(Contract W-7405-eng-48)
(LBL-5931; Conf-771112-3) Avail: NTIS HC A04/MF A01

A critical evaluation of data on the viscosity of aqueous sodium chloride solutions is presented. The literature was screened through October 1977, and a data bank of evaluated data was established. Viscosity values were converted when necessary to units of deg C, centipoise and molal concentration. The data were correlated with the aid of an empirical equation to facilitate interpolation and computer calculations. The result of the evaluation includes a table containing smoothed values for the viscosity of NaCl solutions to 150 C. ERA

N78-26188# Los Alamos Scientific Lab., N. Mex.
CATION EXCHANGE OF 53 ELEMENTS IN NITRIC ACID
S. F. Marsh, J. E. Alarid, C. F. Hammond, M. J. McLeod, F. R. Roensch, and J. E. Rein Feb. 1978 10 p refs
(LA-7083) Avail: NTIS HC A02/MF A01

Cation exchange distribution data are presented for 53 elements from 3 to 12M HNO3 for three strong-acid resins, having cross-linkages of 8%, 4%, and macroporous. Data obtained by 16- to 18-h dynamic batch contacts are compared to cation exchange distribution data from strong HClO4. ERA

N78-26189# Amoco Oil Co., Naperville, Ill. Research and Development Dept.
STUDY OF EBULLATED BED FLUID DYNAMICS FOR H-COAL Monthly Progress Report, 1-31 Dec. 1977
I. A. Vasalos, E. M. Bild, T. D. Evans, D. F. Tatterson, A. P. VanderKlay, and C. C. Wallin Jan. 1978 14 p
(Contract EF-77-C-01-2588)
(FE-2588-4; MPR-4) Avail: NTIS HC A02/MF A01

The area of gas-liquid-solid fluidization is of increasing research interest. Much of this research is stimulated by industrial applications of ebullating bed reactors, such as the H-oil, H-coal, and Hy-C processes. Expansion data plus the information on

various phase interactions are the basis for several significant models which provide formats for correlating three-phase data. Validation and modification of these modes provide the best basis for future design and control of ebullating bed reactors. Emphasis on various aspects of design and construction of the cold flow unit is continued. Detailed progress in each area includes the following: systems design, recognizing that the most critical factor for completing the construction of the unit is equipment availability, large effort was devoted to ordering equipment. Progress on equipment procurement and costs are reported. Laboratory tests were also conducted to evaluate a flow meter (micromotion) for measuring recycle slurry flow. ERA

N78-26190# Georgetown Univ., Washington, D.C.
INDUSTRIAL APPLICATION OF FLUIDIZED-BED COMBUSTION Quarterly Technical Progress Report, Jul. - Sep. 1977
Oct. 1977 15 p
(Contract EX-76-C-01-2461)
(FE-2461-5) Avail: NTIS HC A02/MF A01

Progress is reported in the design of a prototype plant and atmospheric fluidized bed boiler for burning high sulfur coals in an environmentally acceptable manner in an urban institutional complex. The boiler, to be located on the Georgetown University campus, will have the capacity to generate 100,000 pounds per hour of saturated steam. Data from the prototype operation will be used in the design and construction of commercially warranted industrial size fluidized bed boiler units. A.R.H.

N78-26191# Los Alamos Scientific Lab., N. Mex.
PROCEDURE FOR THE ANALYSIS OF AMERICIUM IN COMPLEX MATRICES
Daryl Knab Feb. 1978 13 p refs
(Contract W-7405-eng-36)
(LA-7057) Avail: NTIS HC A02/MF A01

A radioanalytical procedure for the analysis of americium in complex matrices was developed. Clean separations of americium can be obtained from up to 100 g of sample ash, regardless of the starting material. The ability to analyze large masses of material provides the increased sensitivity necessary to detect americium in many environmental samples. The procedure adequately decontaminates from rare earth elements and natural radioactive nuclides that interfere with the alpha spectrometric measurements. ERA

N78-26192# Battelle Columbus Labs., Ohio.
LASER SPECTROSCOPY FOR CONTINUOUS COMBUSTION APPLICATIONS
Russell H. Barnes, Anthony A. Boiarski, and John F. Kircher 30 Sep. 1977 47 p refs
(Contract W-7405-eng-92-088)
(BMI-1982) Avail: NTIS HC A03/MF A01

Laser spectroscopy including both fluorescence and Raman techniques are being developed for application to continuous combustion systems. Feasibility of in-situ flame measurement of NO2 was demonstrated by observation of NO2 in a one atmosphere methane/air flame. Excitation fluorescence spectra were obtained in the wavelength region from about 4300 to 5000A using a tunable dye laser pumped with a pulsed N2 laser. For laser Raman studies codes were developed for CO, CO2, and H2O. The temperature correction required to obtain species number density from the Raman measurement under combustion conditions is demonstrated. ERA

N78-26193# California Univ., Berkeley. Lawrence Berkeley Lab.
INTERACTION OF A PLANE FLAME FRONT WITH THE WAKE OF A CYLINDER
I. Namer, Y. Agrawal, R. K. Cheng, F. Robben, R. Schefer, and L. Talbot Oct. 1977 36 p refs Presented at Fall Meeting of the Western States Section of the Combustion Inst., Palo Alto, Calif., 17 Oct. 1977
(Contract W-7405-eng-48)
(CONF-771015-13) Avail: NTIS HC A03/MF A01

A Rayleigh scattering and laser Doppler velocimetry system was developed for studying the interaction between the vortex street behind a cylinder and a two dimensional plane flame front. Measurements on an open jet methane/air flame stabilized on a heated 0.25 mm platinum wire showed appreciable instabilities in the flame due to the turbulent eddies in the mixing region of the jet. By enclosing the flow in a square channel flame stability was increased. A 3.2 mm diameter cylinder, with Ud/v = 90 fd/U = 0.16, was used to generate a Karman vortex street at a frequency of 22 Hz. Measurements indicated that the flame motion in the wake is small compared to the scale of vortices shed by the cylinder, but the rms fluctuations in velocity in the wake of the cylinder were comparable to the rms fluctuations in Rayleigh scattering through the flame. The flame upstream of the wake region also fluctuated which would indicate that as a portion of the flame fluctuates, it perturbs the entire flow field upstream. ERA

N78-26194*# National Bureau of Standards, Boulder, Colo. Cryogenics Div.
PRODUCING LIQUID-SOLID MIXTURES OF HYDROGEN USING AN AUGER
R. O. Voth Feb. 1978 21 p refs
(NASA Order CC-62530A)
(NASA-CR-156933; PB-278723/2; NBSIR-78-875) Avail: NTIS HC A02/MF A01 CSCL 07D

An auger rotating inside a brass tube refrigerated with liquid helium was used to produce liquid-solid (slush) mixtures of hydrogen. The auger produced small particles of solid hydrogen so that the resulting mixture could be transferred and stored. The auger produced slush continuously in an appropriate system; it produced slush at pressures higher than the triple point pressure of the hydrogen; and the triple energy required to produce the slush was less than the energy required to produce slush hydrogen using the freeze-thaw process. GRA

N78-26195 National Technical Information Service, Springfield, Va.
CHEMICAL ANALYSIS TECHNIQUES OF TRACE ELEMENTS, VOLUME 1. A BIBLIOGRAPHY WITH ABSTRACTS Progress Report, 1964 - 1975
Diane M. Cavagnaro Apr. 1978 223 p
(NTIS/PS-78/0321/6) Avail: NTIS HC $28.00/MF $28.00 CSCL 07D

Federally-funded research reports cover analytical techniques and laboratory equipment used to analyze trace elements. Some of the applications include detection of pollution, biological samples, and fuels. The citations discuss the techniques of polarography, spectrochemical analysis, gas chromatography, ion exchange, separation, extraction, distillation, X-ray fluorescence analysis, and neutron activation analysis. GRA

N78-26196 National Technical Information Service, Springfield, Va.
CHEMICAL ANALYSIS TECHNIQUES OF TRACE ELEMENTS, VOLUME 2. A BIBLIOGRAPHY WITH ABSTRACTS Progress Report, 1976 - Mar. 1978
Diane M. Cavagnaro Apr. 1978 273 p
(NTIS/PS-78/0322/4) Avail: NTIS HC $28.00/MF $28.00 CSCL 07D

Citations are presented describing different chemical analysis techniques and equipment used in trace element analysis. Many of the reports pertain to pollution detection. Some of the techniques include polarography, spectroscopy, gas chromatography, ion exchanging, separation, extraction, distillation, X-ray fluorescence analysis, and neutron activation analysis. GRA

N78-26271# General Motors Research Labs., Warren, Mich.
SOME COMMENTS ON THE EXTERNAL COMBUSTION ENGINE
James E. Bennethum *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 2: Stirling Cycle Anal. and Eng. Design Studies Apr. 1978 5 p (For availability see N78-26262 17-31)
(GMR-2690-Sect-2.109) Avail: NTIS HC A14/MF A01

26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

N78-26197 Nebraska Univ., Lincoln.
MAGNETIC AND ELECTRONIC PROPERTIES OF AMORPHOUS METALLIC ALLOYS Ph.D. Thesis
Greg Robert Gruzalski 1977 170 p
Avail: Univ. Microfilms Order No. 7809153

Magnetic susceptibility and high-field magnetization measurements are presented for amorphous Zr40Cu60-xMx (M denoting Fe, Mn, Gd, and Tb) and Nb50Ni50-xFex, with x ranging from zero to ten. Hysteresis data were used to obtain the temperature dependence of the coercive fields H sub C and to determine ordering temperatures, defined as those temperatures for which H sub C vanishes. The magnetic properties of these alloys are discussed in terms of local random anisotropy, fluctuations in interimpurity exchange interactions, extremely short electron-mean-free paths, antiferromagnetic interactions between the localized moments and the conduction electrons, and moment instabilities. The results of calculations on the local-random-anisotropy model for amorphous magnetism are also presented. Low temperature hysteresis loops as well as the temperature dependence of several thermodynamic quantities are presented. The magnetic phase diagram for the equilibrium states is constructed, and paramagnetic, random ferromagnetic, and random antiferromagnetic regions are identified. Electrical resistivity and magnetic susceptibility measurements for amorphous ZrxPd100-x (x = 59,63,67,70) are also presented.
Dissert. Abstr.

N78-26198*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ROLE OF ALLOYING ELEMENTS IN ADHESIVE TRANSFER AND FRICTION OF COPPER-BASE ALLOYS
Donald H. Buckley Jun. 1978 19 p refs
(NASA-TP-1256; E-9471) Avail: NTIS HC A02/MF A01 CSCL 11F

Sliding friction experiments were conducted in a vacuum with binary-copper alloy riders sliding against a conventional bearing-steel surface with normal residual oxides present. The binary alloys contained 1 atomic percent of various alloying elements. Auger spectroscopy analysis was used to monitor the adhesive transfer of the copper alloys to the bearing-steel surface. A relation was found to exist between adhesive transfer and the reaction potential and free energy of formation of the alloying element in the copper. The more chemically active the element and the more stable its oxide, the greater was the adhesive transfer and wear of the copper alloy. Transfer occurred in all the alloys except copper-gold after relatively few (25) passes across the steel surface. Author

N78-26199*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MORPHOLOGY OF GOLD AND COPPER ION-PLATED COATINGS
Talivaldis Spalvins Jun. 1978 17 p refs
(NASA-TP-1262; E-9528) Avail: NTIS HC A02/MF A01 CSCL 11F

Copper and gold films (0.2 to 2 microns thick) were ion plated onto polished 304-stainless-steel, glass, mica surfaces. These coatings were examined by SEM for defects in their morphological growth. Three types of defects were distinguished: nodular growth, abnormal or runaway growth, and spits. The cause for each type of defect was investigated. Nodular growth is due to inherent substrate microdefects, abnormal or runaway growth is due to external surface inclusions, and spits are due to nonuniform evaporation (ejection of droplets). All these defects induce stresses and produce porosity in the coatings and thus weaken their mechanical properties. During surface rubbing, large nodules are pulled out, leaving vacancies in the coatings. Author

N78-26200# Southwest Research Inst., San Antonio, Tex. Dept. of Materials Sciences.
CHARACTERIZATION OF FATIGUE CRACK TIP DEFORMATION Final Report, 1 Jan. 1975 - 31 Dec. 1977
James Lankford, Jr. and David L. Davidson Feb. 1978 20 p refs
(Contract F44620-75-C-0050; SwRI Proj. 02-4167)
(AD-A052881; AFOSR-78-0490TR) Avail: NTIS HC A02/MF A01 CSCL 20/11

During the past three years, fatigue crack tip plasticity and overload induced fatigue crack retardation have been studied using several complementary techniques, especially selected area electron channeling and high resolution SEM observation of crack tips under various stages of loading. It is found that while some materials exhibit plastic yielding behavior in agreement with existing theory, some materials, especially aluminum alloys, diverge widely both from one another and from theory. In particular, for equivalent stress intensities, overload ratios, and pre-overload crack growth rates, the retardation period (in cycles) for 2024-T3 significantly exceeds that for 6061-T6 and 7075- T6. This behavior is intimately related to the size and shape of the overload plastic zone, variations which probably are controlled by the plastic flow rules for the alloys. GRA

N78-26201# Texas Univ., Austin. Dept. of Mechanical Engineering.
THE INFLUENCE OF HOLD TIMES ON FATIGUE CRACK GROWTH OF ALUMINUM ALLOYS Annual Technical Report, 1 Jan. - 31 Dec. 1977
Harris L. Marcus 14 Feb. 1978 18 p refs
(Grant AF-AFOSR-2955-76; AF Proj. 2306)
(AD-A052882; AFOSR-78-0489TR) Avail: NTIS HC A02/MF A01 CSCL 11/6

The main emphasis during the present contract year has been in four areas: (1) The influence of underload times on fatigue crack growth retardation, (2) investigation of crack closure, (3) the influence of crack surface roughness on acoustic energy transmission, and (4) the influence environment has on the fatigue fracture surface. These will be discussed separately. GRA

N78-26202# Pratt and Whitney Aircraft Group, West Palm Beach, Fla. Government Products Div.
TITANIUM DAMAGE TOLERANT DESIGN DATA FOR PROPULSION SYSTEMS Final Report, 1 Jun. 1975 - 30 Apr. 1977
James R. Beyer, David L. Sims, and Raymond M. Wallace Aug. 1977 93 p refs
(Contract F33615-75-C-5130)
(AD-A053252; FR-8480; AFML-TR-77-101) Avail: NTIS HC A05/MF A01 CSCL 11/6

The program consisted of crack growth threshold, crack growth rate, and fracture toughness testing for each alloy plus strain controlled low cycle fatigue crack initiation testing on Ti 8-1-1. The effects of stress ratio, cyclic frequency, and temperature were determined, providing a broad data base for damage tolerant design of titanium gas turbine engine components. GRA

N78-26203# Georgia Inst. of Tech., Atlanta. School of Chemical Engineering and Metallurgy.
QUANTITATIVE STEREOLOGICAL METHODS FOR ANALYZING IMPORTANT MICROSTRUCTURAL FEATURES IN FATIGUE OF METALS AND ALLOYS
E. E. Underwood and E. A. Starke, Jr. 6 Apr. 1978 42 p refs
(Contract N00014-75-C-0349; Grant AF-AFOSR-3471-78)
(AD-A053363; GIT-TR-78-1) Avail: NTIS HC A03/MF A01 CSCL 11/6

This paper reviews the practical aspects of extracting quantitative microstructural data from fatigue microstructures. In addition to the basic stereological information needed to characterize the essential elements of the structure, special methods are developed and described for quantifying more subtle effects. Thus, elongated structures, lamellar systems, gradients, and locational characteristics of particles are considered with respect to the fatigue process and its interactions with the microstructural features. Author (GRA)

N78-26204# Naval Surface Weapons Center, White Oak, Md.
ELASTIC VERSUS MAGNETOELASTIC ANISOTROPY IN RARE EARTH-IRON ALLOYS Summary Report, 1 Nov. 1976 - 1 Nov. 1977
J. R. Cullen, S. Rinaldi, and G. V. Blessing 1 Nov. 1977 32 p refs
(AD-A053263; NSWC/WOL/TR77-180) Avail: NTIS HC A03/MF A01 CSCL 11/6

A review is presented of recent results of ultrasonic investigations of rare earth-iron compounds and alloys. The

discussion is divided into three sections. The first describes results of sound velocity measurements of single crystal Tb.3Dy.7Fe2 as a function of magnetic field strength and orientation with respect to the crystallographic axes. In the second part recent work on polycrystalline and amorphous samples, including evidence for simultaneous propagation of two different types of magnetoelastic waves is presented. A model developed to describe this phenomenon is outlined as well. Finally a transmission experiment in a single crystal (Tb.3DY.7Fe2) is described. Resonant-like transmission is shown to take place when an applied magnetic field is so oriented as to produce almost equal velocities for C44 and C11-C12 modes. Author (GRA)

N78-26205# Instituto Nacional de Tecnica Aeroespacial, Esteban Terradas, Torrejon de Ardoz (Spain).
DETERMINATION OF THE MORPHOLOGY AND THE CONSTITUENT OF SEVERAL STAINLESS STEELS
Amador AlonsoRoldan, Agustin SanchezPascual, and Jose Maria BadiaPerez 1977 16 p refs In SPANISH; ENGLISH summary Presented at the 4th Gen. Meeting of the Centro Nacl. de Invest. Met. (CENIM), Madrid, May - Jun. 1977
Avail: NTIS HC A02/MF A01

An examination is presented of constituents existing in various types of stainless steels from the viewpoint of their composition and morphology. Once the normal microstructure of such steels at room temperature was known, they were subjected to a series of thermal cycles to allow a comparative study of the evolution of the various constituents. The new constituents formed as a result of high-temperature holding were also considered. Special attention was given to both the study of the morphology and composition of those constituents which (as in the case of ferrite and sigma phase) influence the mechanical properties and the corrosion behavior of such steels. The identification of constituents was effected by means of conventional metallographical techniques based on the magnetic permeability combined with X-ray analysis. Author (ESA)

N78-26206# Instituto Nacional de Tecnica Aeroespacial, Esteban Terradas, Torrejon de Ardoz (Spain).
EFFECT OF COLD PLASTIC DEFORMATION ON THE SPECTRAL EMISSION OF Cu, Pb, Sn AND THEIR ALLOYS
J. M. LopezdeAzcona and E. AsensiAlvarez-Arenas 1977 13 p refs In SPANISH; ENGLISH summary Presented at the 4th Gen. Meeting of the Centro Nacl. de Invest. Met. (CENIM), Madrid, May - Jun. 1977
Avail: NTIS HC A02/MF A01

Results are presented of a study covering the effect of cold plastic deformation on the spectral emission of Cu, Pb, Sn, and their alloys. An automatic spectrometer was used and the effect of the distortion degree for metals and alloys was observed. ESA

N78-26207# Instituto Nacional de Tecnica Aeroespacial, Esteban Terradas, Torrejon de Ardoz (Spain).
METALLOGRAPHY OF TITANIUM AND ITS ALLOYS
J. A. GarciaPoggio, E. AsensiAlvarez-Arenas, and D. DeRuedalbanez 1977 13 p refs In SPANISH; ENGLISH summary Presented at the 4th Gen. Meeting of the Centro Nacl. de Invest. Met. (CENIM), Madrid, May - Jun. 1977
Avail: NTIS HC A02/MF A01

Some titanium alloys belonging to the alpha or alpha-beta group were studied, and a method is presented for preparation of metallographic samples which in certain cases can compete with the electrolytic polishing method. Several attack reactions were considered in order to determine the microstructural constituents of titanium and its alloys, and the most appropriate reactions for these materials are indicated. ESA

N78-26208# Instituto Nacional de Tecnica Aeroespacial, Esteban Terradas, Torrejon de Ardoz (Spain).
MACRO AND MICROMORPHOLOGICAL CHARACTERISTICS OF STEEL AND ALUMINIUM SAMPLES CRACKED BY FATIGUE
Jose Maria PintadoFe, Amador AlonsoRoldan, and Jose Maria BadiaPerez 1977 11 p In SPANISH; ENGLISH summary Presented at the 4th Gen. Meeting of the Centro Nacl. de Invest. Met. (CENIM), Madrid, May - Jun. 1977
Avail: NTIS HC A02/MF A01

The results of macro- and microfractographic classification and analysis of fatigue cracks on aluminum wires and standard steel specimens, tested in alternative and rotative bending, are reported. Evident limiting values of cycles to rupture and stress levels were noted in aluminum wire showing two different breakage morphologies. Macrofractographic characteristics of steel samples were determined and interpreted, and their effect on material strength was examined. ESA

N78-26209# Instituto Nacional de Tecnica Aeroespacial, Esteban Terradas, Torrejon de Ardoz (Spain).
METALLURGICAL APPLICATIONS OF THE INTERFERENTIAL MICROSCOPY WITH POLARIZED LIGHT
E. AsensiAlvarez-Arenas and D. DeRuedalbanez 1977 11 p refs In SPANISH; ENGLISH summary Presented at the 4th Gen. Meeting of the Centro Nacl. de Invest. Met. (CENIM), Madrid, May - Jun. 1977
Avail: NTIS HC A02/MF A01

Several applications of the interferential contrast method of Nomarski are presented. Included are the determination of the corrosion sensitivity of austenitic stainless steels and discrimination of ferrite and austenite in stainless steels. The effect of the interpretation of results upon the polishing methods of specimen is also considered. ESA

N78-26210# Instituto Nacional de Tecnica Aeroespacial, Esteban Terradas, Torrejon de Ardoz (Spain).
CAUSES FOR CRACKING IN TOOL STEELS
M. DelaTorreAlbarsanz 1977 13 p In SPANISH; ENGLISH summary Presented at the 4th Gen. Meeting of the Centro Nacl. de Invest. Met. (CENIM), Madrid, May - Jun. 1977
Avail: NTIS HC A02/MF A01

Causes of concrete cracking are reported for tools manufactured in high speed steels, oil and air hardening steels, and wear resisting steels, distinguishing these from causes based on thermal treatment, deficient design, or manufacturing inaccuracies. ESA

N78-26211# Instituto Nacional de Tecnica Aeroespacial, Esteban Terradas, Torrejon de Ardoz (Spain).
EFFECTS OF ALLOYING ELEMENT AND HEAT TREATMENT ON FATIGUE LIMITS OF STEELS [INFLUENCIA DE LOS ELEMENTOS DE ALEACION Y TRATAMIENTOS TERMICOS EN EL LIMITE DE FATIGA DE LOS ACEROS]
Jose Maria PintadoFe, Enrique Julio Garcia Sardinero, and Manuel GarciaFernandez (IBERIA) 1977 12 p In SPANISH; ENGLISH summary
Avail: NTIS HC A02/MF A01

The experimental study focused on the behavior of six different steels, of approximately 0.35% C and various contents of Cr, Ni, and Mo. Each of these steels were tested in order to determine its fatigue limit to 10 million cycles, in 5 different states (normalized and quenched and tempered to 4 different temperatures). The sigma c=f (sigma R) curves are represented in order to detemine the influence of the different alloying elements. Author (ESA)

N78-26212# Metaalinstitut TNO, Apeldoorn (Netherlands).
FAILURE ANALYSIS OF MOLYBDENUM ORIFICES
P. Breedveld and A. P. VonRosenstiel 10 Oct. 1977 10 p refs
(M77/011017; TDCK-69954) Avail: NTIS HC A02/MF A01

The chemical composition and microstructure of molybdenum or Mo-0.5 Ti orifices were investigated in view of the causes for cracks in the barrel orifices appearing only after a few shots. Visual examination and metallographic, spectrochemical, and chemical analysis were carried out. Results are discussed. ESA

N78-26287# General Motors Research Labs., Warren, Mich.
STIRLING ENGINE POWER PISTONS SAE 4340 STEEL
Erwin R. Cprek *In its* A Collection of Stirling Engine Reports from General Motors' Research, 1958 to 1970. Part 3: Stirling Engine Materials and Stresses, 3.1 Stirling Engine Materials, 3.2 Stirling Engine Stresses Apr. 1978 6 p (For availability see N78-26284 17-31)
(GMR-2690-Sect-3.103) Avail: NTIS HC A10/MF A01

N78-26288# General Motors Research Labs., Warren, Mich.
STIRLING ENGINE POWER PISTON SAE 4340 STEEL
Erwin R. Cprek *In its* A Collection of Stirling Engine Reports from General Motors' Research, 1958 to 1970. Part 3: Stirling Engine Materials and Stresses, 3.1 Stirling Engine Materials, 3.2 Stirling Engine Stresses Apr. 1978 7 p (For availability see N78-26284 17-31)
(GMR-2690-Sect-3.104) Avail: NTIS HC A10/MF A01

N78-26290# General Motors Research Labs., Warren, Mich.
ALTERNATE MATERIALS FOR THE 4L23 STIRLING ENGINE
Frederick A. Robbins, II *In its* A Collection of Stirling Engine Reports from General Motors' Research, 1958 to 1970. Part 3: Stirling Engine Materials and Stresses, 3.1 Stirling Engine Materials, 3.2 Stirling Engine Stresses Apr. 1978 6 p (For availability see N78-26284 17-31)
(GMR-2690-Sect-3.106) Avail: NTIS HC A10/MF A01

N78-26335# General Motors Research Labs., Warren, Mich.
METALLURGICAL STUDIES OF HIGH TEMPERATURE ALLOY CAPSULES AFTER LONG TIME CYCLIC CORROSION TESTS AS CONTAINERS FOR LITHIUM FLUORIDE
Erwin R. Cprek *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 7: Thermal Energy Storage and Publ. List, 7.1 Thermal Energy Storage, 7.2 List of Gen. Motors Stirling Eng. Publ. Apr. 1978 23 p (For availability see N78-26326 17-31)
(GMP-2690-Sect-7.109) Avail: NTIS HC A11/MF A01

27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

N78-26213 Pennsylvania State Univ., University Park.
RAMAN SPECTROSCOPIC INVESTIGATION OF THE STRUCTURE AND CRYSTALLIZATION OF LITHIUM-TITANIUM SILICATE GLASSES AND LEAD SILICATE GLASSES Ph.D. Thesis
Toshiharu Furukawa 1977 132 p
Avail: Univ. Microfilms Order No. 7808361

The structure and crystallization of lithium titanium silicate glasses and lead silicate glasses by Raman spectroscopy as a major characterization tool, were investigated. The parallel (xx) and crossed (xy) polarization Raman spectra of the glasses were measured and analyzed. The glasses were crystallized at various subsolidus temperatures and the crystalline phases were characterized by X-ray powder diffraction and Raman spectroscopy. Infrared absorption spectra of glasses and crystals were also measured for the lead silicate system. Differential thermal analysis and hydrothermal crystallization of glasses were useful for the study of phase relations of the crystals crystallized from glasses. The crystallization behavior of glasses was unpredictable from the equilibrium phase diagram especially at low temperature. Dissert. Abstr.

N78-26214*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SPUTTERING TECHNOLOGY IN SOLID FILM LUBRICATION
Talivaldis Spalvins 1978 18 p refs To be presented at the 2d Intern. Conf. on Solid Lubrication, Denver, 14-18 Aug. 1978; sponsored by the Am. Soc. of Lub. Engr.
(NASA-TM-78914) Avail: NTIS HC A02/MF A01 CSCL 11H

Potential and present sputtering technology is discussed as it applies to the deposition of solid film lubricants, particularly MoS2, WS2, and PTFE. Since the sputtered films are very thin, the selection of the sputtering parameters and substrate condition is very critical as reflected by the lubricating properties. It was shown with sputtered MoS2 films that the lubricating characteristics are directly affected by the selected sputtering parameters (power density, pressure, sputter etching, dc-biasing, etc.) and the substrate temperature, chemistry, topography and the environmental conditions during the friction tests. Electron microscopy and other surface sensitive analytical techniques illustrate the resulting changes in sputtered MoS2 film morphology and chemistry which directly influence the film adherence and frictional properties. G.G.

N78-26215*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A COMPARISON OF THE LUBRICATING MECHANISMS OF GRAPHITE FLUORIDE AND MOLYBDENUM DISULFIDE FILMS
Robert L. Fusaro Aug. 1978 42 p refs Proposed for presentation at the 2d Intern. Conf. on Solid Lubrication, Denver, 14-18 Aug. 1978; sponsored by the Am. Soc. of Lubrication Engr.
(NASA-TM-78897; E-9633) Avail: NTIS HC A03/MF A01 CSCL 11H

A microscopic study of 440C steel sliding surfaces lubricated by graphite fluoride or molybdenum disulfide solid lubricant rubbed films was conducted. The sliding surfaces, along with the friction, wear, and wear life were observed as a function of the number of sliding revolutions in three different atmospheres: moist air, dry air, or dry argon. In general, the lubricating mechanisms of the two solid lubricants were found to be relatively similar; that is, a dynamic, thin, layer-like film was formed between the two metallic surfaces. The mechanisms of failure were found to be somewhat different, however. Failure of MoS2 films was very dependent on atmospheric degradation, while that of graphite fluoride films was more dependent on flow of the lubricant film out of the contact zone. Author

N78-26216*# Georgia Inst. of Tech., Atlanta.
SURFACE TEMPERATURES AND GLASSY STATE INVESTIGATIONS IN TRIBOLOGY, PART 1 Final Report
Ward O. Winer and David M. Sanborn Jun. 1978 128 p refs
(Grant NsG-3106)
(NASA-CR-3031) Avail: NTIS HC A07/MF A01 CSCL 20L

The research in this report is divided into two categories: (1) lubricant rheological behavior, and (2) thermal behavior of a simulated elastohydrodynamic contact. The studies of the lubricant rheological behavior consists of high pressure, low shear rate viscosity measurements, viscoelastic transition measurements, by volume dilatometry, dielectric transitions at atmospheric pressure and light scattering transitions. Lubricant shear stress-strain behavior in the amorphous glassy state was measured on several fluids. It appears clear from these investigations that many lubricants undergo viscoplastic transitions in typical EHD contacts and that the lubricant has a limiting maximum shear stress it can support which in turn will determine the traction in the contact except in cases of very low slide-roll ratio. Surface temperature measurements were made for a naphthenic mineral oil and a polyphenyl ether. The maximum surface temperature in these experiments was approximately symmetrical about the zero slide-roll ration except for absolute values of slide-roll ratio greater than about 0.9. Additional surface temperature measurements were made in contacts with rough surfaces where the composite surface roughness was approximately equal to the EHD film thickness. A regression analysis was done to obtain a predictive equation for surface temperatures as a function of pressure, sliding speed, and surface roughness. A correction factor for surface roughness effects to the typical flash temperature analysis was found. Author

N78-26217# Westinghouse Electric Corp., Pittsburgh, Pa. Advanced Energy Systems Div.
DEVELOPMENT, TESTING, AND EVALUATION OF MHD MATERIALS AND COMPONENT DESIGNS Quarterly Report, 1 Apr. - 30 Jun. 1977
J. W. Sadler, W. E. Young, L. H. Codoff, J. A. Dilmore, E. L. Kochka, J. A. Kuszyk, J. Lempert, B. R. Rossing, S. J. Schneider, and A. B. Turner Jul. 1977 106 p refs
(Contract EX-76-C-01-2248)
(FE-2248-15) Avail: NTIS HC A06/MF A01

Ceramic MHD electrodes for both clean fuel and coal fired environments were designed, fabricated, and evaluated. The tests verified design prediction of material temperatures and heat fluxes. Both the test facility and test section demonstrated their suitability as test vehicles for long duration testing of generator materials and designs. A number of designs reflecting various

electrode to copper cooling block attachment techniques were examined. These techniques involved the use of a compliant material (metal or organic) to reduce mechanical stresses in the ceramic electrode structures. Laboratory screening tests indicate that both MgCr2O4 and MO2Si are resistant to slag corrosion and can be seriously considered as anode materials for semi-hot slagging wall operation (T/sub wall/ = 900 to .1500 C). ERA

N78-26218# General Electric Co., St. Petersburg, Fla. Neutron Devices Dept.
DIELECTRIC CHARACTERISTICS OF PZT 95/5 FERROELECTRIC CERAMICS AT HIGH PRESSURES
R. K. Spears 31 Jan. 1978 89 p refs
(Contract EY-76-C-04-0656)
(GEPP-308) Avail: NTIS HC A05/MF A01

The room temperature dielectric properties of a ferroelectric ceramic having a nominal composition of 95 atomic percent lead zirconate and 5 atomic percent lead titanate (designated as PZT 95/5) with a niobium dopant were examined at high hydrostatic pressures using a tetrahedral anvil apparatus. This ceramic has practical applications as a power source in which large quantities of charge are released by dynamic (shock wave) depolarization. Numerous mathematical models of this process have been proposed; however, the use of models has been limited because of the lack of high pressure electrical properties. This study attempted to provide these data on PZT 95/5 determining the small signal and high electric field dielectric properties at pressures over 4 GPA. ERA

N78-26219# California Univ., Livermore. Lawrence Livermore Lab.
PLASMA POLYMERIZATION COATING OF D-T FILLED GLASS SHELLS FOR LASER FUSION TARGETS
W. L. Johnson, C.W. Hatcher, C. D. Hendricks, S. A. Letts, and L. E. Lorensen 30 Sep. 1977 6 p refs Presented at Topical Meeting on Inertial Confinement Fusion, San Diego, Calif., 7 Feb. 1978
(Contract W-7405-eng-48)
(UCRL-80162; Conf-780202-15) Avail: NTIS HC A02/MF A01

Three plasma sources are described which activate monomers of perfluoro-2-butene or tetrafluoroethylene to produce coatings 10 to 20 microns thick with surface finishes less than 0.1 micron. Electrical and chemical controls of the polymerization processes are shown to improve the surface finish. ERA

N78-26220# Royal Netherlands Aircraft Factories Fokker, Schiphol-Oost. Manufacturing Research and Product Development Dept.
ADHESION OF EROSION RESISTANT TAPES ON SEVERAL SURFACE CONFIGURATIONS
J. A Cromwijk Apr. 1977 6 p
(FOK-R-2132) Avail: NTIS HC A02/MF A01

The leading edges of the F-28 aircraft suffer from severe erosion, especially in tropic environments. To get an impression of the adhesion of the tapes to the several surface configurations an investigation was carried out using tape Y-8562 for application to leading edges with a thermal de-icing system and limited film thickness. Tape type U-8598 was tested for application to leading edges with no limitation in film thickness. Author (ESA)

N78-26221# Royal Netherlands Aircraft Factories Fokker, Schiphol-Oost. Manufacturing Research and Product Development Dept.
SPACELAB: TESTING OF METALBOND 328 WC AND FOAM ADHESIVE BSL 208/5
W. Cleven 13 Sep. 1977 30 p refs
(FOK-R-2162) Avail: NTIS HC A03/MF A01

Tests were carried out on metal-to-metal, metal-to-honeycomb, and honeycomb-core splice joints in order to obtain information for design allowables for METALBOND 328 WC adhesive film and core splice adhesive BSL 208/5. Adhesive M 328 WC is the same adhesive as M328 type I used for the F-28 structure; however, the M 328 WC is unsupported. According to material specification TH 37.0103 the specific weight of the film is 2.25 + or - N/sq m and the nominal film thickness is 0.16 mm. It was found that 328 WC adhesive is temperature stable up to at least 110 C, strength retention of all the 110 C tests is above 70% as compared to room temperature tests, all but one flexural shear test. Specimen failed by shear in the honeycomb core, and core splice adhesive BSL 208/5 is functional in the tested configuration at a temperature of at least 110 C. ESA

N78-26222# Gulf South Research Inst., New Orleans, La.
NEW POLYMERIC MEMBRANE CONTAINING PHOSPHONATE ESTER GROUPS FOR DESALINATION Final Report, 25 Jun. 1976 - 24 Jun. 1977
Israel Cabasso and Chinh Nogh Tran 15 Nov. 1977 64 p refs
(Contract DI-14-34-0001-6523)
(PB-278038/5; W78-04500; OWRT/S-78/4) Avail: NTIS HC A04/MF A01 CSCL 07D

A membrane consisting of poly(2,6-dimethyl-1,4-bromophenylene oxide) dimethyl phosphonate ester alloyed with cellulose acetate was developed and was efficient in separating salt from saline solution in the reverse osmosis process. The membrane was cast to have an asymmetric morphology. The casting solution was polyphosphonate/cellulose acetate (1/1 by weight). The membrane displayed high salt rejection, a high water permeation rate, and excellent chemical and mechanical stability. GRA

28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers, storage and handling; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

N78-26223* National Aeronautics and Space Administration, Washington, D. C.
AVIATION FUELS BEYOND THE 1980'S
Willson H. Hunter (NASA Senior Sci. Representative, Canberra, Australia) 1978 17 p refs Presented at the Symp. on Aviation Fuel in the 1980's, Melbourne, 26-27 Jun. 1978; sponsored by the Inst. of Engr. Australia and the Australian Inst. of Petrol.
(NASA-TM-79510) Avail: Issuing Activity CSCL 21D

The competitive use and effect of coal-derived synthetic JET-A and cryogenic liquid methane (LCH4) and liquid hydrogen (LH2) fuels on the design, mass and operation of large subsonic, supersonic and hypersonic transport aircraft are analyzed. Overall energy and cost efficiency comparisons are presented from studies of JET-A and LH2 fuels usage in subsonic and supersonic transports. The probable concerns of the public and the aviation industry over the use of the coal-derived fuels are discussed. The possibility that space-flight-vehicle-derived technology may be applied to special purpose passenger transports is considered. The likelihood that petroleum-derived fuels similar to JET-A will continue in major use in aviation for the foreseeable future is predicted. Author

N78-26224# Illinois Univ., Urbana. Dept. of Civil Engineering.
BIOLOGICAL CONVERSION OF BIOMASS TO METHANE Annual Progress Report, 1 Jun. 1976 - 31 May 1977
John T. Pfeffer Jun. 1977 78 p
(Contract EY-76-S-02-2917)
(COO-2917-5) Avail: NTIS HC A05/MF A01

A large scale laboratory system was constructed to evaluate the methane yields from various organic materials. The initial substrate used was beef feed hot manure. Methane yields ranged from 0.11 to 0.259 sq m per kg volatile solids fed with a fermentation temperature of 58 C. The gas yield for a given manure was a function of retention time. However, fresh manure produced substantially more gas than manure that had lain on the lot for several months. Reaction times of 3.7 days and loadings of 8.76 kg per cu m per day resulted in stable operation. ERA

N78-26225# Department of Energy, Bartlesville, Okla. Energy Research Center.
EXPERIMENTS WITH NOVEL FUELS FOR DIESEL ENGINES

W. F. Marshall Feb. 1978 7 p
(BERC/TPR-77/8) Avail: NTIS HC A02/MF A01

Engine tests were conducted with two fuels that would be considered as novel for use in diesel engines. The fuels, methanol and a water/diesel fuel emulsion, were used because of their potential for reductions in exhaust emissions. The test results showed that these fuels yield no advantages over standard diesel fuel with respect to emissions of unburned hydrocarbons and oxides of nitrogen. Although smoke and carbon monoxide emissions were reduced with the use of the water/fuel emulsion, the same effect could also be achieved via engine adjustment. ERA

N78-26226# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
IMPACT OF ALTERNATE FUELS ON REFRACTORIES AND REFRACTORY INSULATIONS
May 1977 67 p refs Sem. held in Washington, D.C., 21 Sep. 1976
(Contract W-7405-eng-26)
(ORNL-TM-5895-Add; Conf-7609156) Avail: NTIS HC A04/MF A01

Topics covered in the seminar include: assessment of the impact of alternate fuels on refractories and refractory insulations; alternate fuel experience in refractory manufacturing; slagging of refractories by ash from alternate fuels; and substitution of coal for natural gas in face brick production. A panel discussion following the formal presentations is summarized. Author (ERA)

N78-26227# Department of Energy, Washington, D. C. Div. of Environmental Control Technology.
APPROACH TO LIQUEFIED NATURAL GAS (LNG) SAFETY AND ENVIRONMENTAL CONTROL RESEARCH
Feb. 1978 464 p refs
(Contracts EY-76-C-06-1830; EE-77-C-02-4234; EE-77-C-02-4204; W-7405-eng-48; EY-76-C-08-0020)
(DOE/EV-0002) Avail: NTIS HC A20/MF A01

LNG safety and control information is presented for use by industry, regulatory bodies, and the general public. To achieve verified predictive capabilities and verified control methods, activities in six technical elements were identified: vapor generation and dispersion; fire and radiation hazards; flame propagation; release prevention and control; instrumentation and technique development; and scale effects experiments. ERA

N78-26228# Institute of Gas Technology, Chicago, Ill.
DEVELOPMENT OF THE STEAM-IRON PROCESS FOR HYDROGEN PRODUCTION Quarterly Report, 1 Apr. - 30 Jun. 1977
Nov. 1977 47 p ref
(Contracts EX-76-C-01-2435; EF-77-C-01-2435; Proj. 9010) (FE-2435-16; QR-4) Avail: NTIS HC A03/MF A01

The purpose of this project is to initiate operational evaluation of the steam-iron pilot plant for the production of hydrogen and to carry out the necessary supporting research. The overall program plan is divided into seven tasks: (1) Reactor System Start-up; (2) Reactor System Variables Study; (3) Design of Static Blade Test Equipment; (4) Kinetic Studies; (5) Char Evaluation; (6) Attrition Studies; and (7) Lift-Line Studies. During the present quarter, one ore circulation and one char feed test were completed. In the char feed test, 47 tons of char were fed at rates up to 3/4 tons/hr and a char bed of 12 feet was maintained for 80 hours. Bed temperatures were increased to 1275 F to initiate char gasification. Ore was circulated at 5 tons/hr for a period of 30 hours under full automatic control. By replacing the internals of the life-line expansion joint with metal components, interruption in solid circulation, caused by chips of refractory and ceramics, were successfully eliminated. Modification of the upper solids control valve also improved operations. Additional bed level measurement devices are being installed to further improve solids circulation and allow study of reactor operating variables. G.Y.

N78-26229# California Univ., Berkeley. Lawrence Berkeley Lab. Energy and Environments Div.
STUDY OF THE FERMENTATION OF XYLOSE TO ETHANOL BY FUSARIUM OXYSPORUM M.S. Thesis
T. R. Batter and C. R. Wilke Jun. 1977 106 p refs
(Contract W-7405-eng-48)
(LBL-6351) Avail: NTIS HC A06/MF A01

Using pure xylose as a carbon source, the optimum temperature for growth was found to be 30 C and the optimum pH was found to be 5. The ethanol yield factor was determined to be 0.41 g ethanol/g xylose fermented. The cell mass yield factor was found to be 0.12 g cell mass/g xylose fermented. Kinetic growth data indicate that growth is not exponential, but rather it appears to be linear showing that the increase in the cell mass of the culture occurs at a constant rate. Studies on the effect of increasing ethanol concentrations on the growth of the organism show that decreased growth rates are apparent at concentrations of ethanol greater than 1.5% by wt, and growth is completely halted at concentrations greater than 4.1% by wt. Batch data also indicate that a growth associated inhibitory substance, as yet unidentified, is also present resulting in a cessation of fungal growth before all xylose is utilized. ERA

N78-26230# Sandia Labs., Albuquerque, N. Mex. Detonating Components Div.
SHOCK SENSITIVITY OF POROUS HNS EXPLOSIVE
D. B. Hayes and Dennis E. Mitchell Dec. 1977 20 p refs
(Contract EY-76-C-04-0789)
(SAND-77-1363) Avail: NTIS HC A02/MF A01

A model for treating shock compaction and subsequent chemical reaction of porous HNS high explosive at initial density 1.6 Mg/cu m was tested against some plane shock initiation experiments. Basically, the model treats the initially porous HNS as a pseudothermodynamic phase, and the compaction process as a phase change. The kinetics that govern subsequent chemical reaction were determined from gas gum experiments. Computational experiments were performed using the model to determine the threshold pressure sufficient to produce a detonation in the HNS specimen. Threshold pressure was found to depend on the input pulse duration. ERA

N78-26231# California Univ., Livermore. Lawrence Livermore Lab.
PROPERTIES OF KEL F-800 POLYMER
W. E. Cady and L. E. Caley 21 Jul. 1977 37 p refs
(Contract W-7405-eng-48)
(UCRL-52301) Avail: NTIS HC A03/MF A01

The Kel-F800 fluorocarbon polymer was selected as the binder for the TATB explosive in the B77 bomb. Kel F-800 is a 3M copolymer derived from the monomers chlorotrifluorethylene and vinylidine fluoride. To understand and define Kel F-800 in relation to its intended use, as well as to generate guidelines for controlling the WR material, a thorough evaluation of its properties and the expected variations from different production lots was made. The research showed that Kel F-800 varies in both mechanical and thermal properties because of its high Tg (glass transition temperature) and because of its crystallinity. However, no evidence that these variables are detrimental to any of the end-use properties of Kel F-800 was found. ERA

N78-26232# Babcock and Wilcox Co., Alliance, Ohio. Research Center.
CHARACTERISTICS OF SOLVENT REFINED COAL: DUAL REGISTER BURNER TESTS Final Report
W. L. Sage, W. Downs, and P. L. Cioffi Jan. 1978 118 p refs
(EPRI Proj. 1235-5)
(EPRI-FP-628) Avail: NTIS HC A06/MF A01

Retrofitting requirements for pulverizers and for a dual register burner were identified. Changes made to the pulverizer included lessening of the grinding pressure, slowing of the grinding elements, changing of the feeder controls, and operating with cold primary air. The dual register burner was equipped with a water cooled coal nozzle, and eddy circulations were minimized in the vicinity of the burner front. These changes were necessary to prevent agglomeration and melting of the solvent refined coal in the equipment. ERA

N78-26233# Institute of Gas Technology, Chicago, Ill.
ASSESSMENT OF THERMOCHEMICAL HYDROGEN PRODUCTION, PROJECT 8994 Progress Report, 1 Jul. - 1 Nov. 1977
J. R. Dafler, S. E. Foh, and J. D. Schreiber Dec. 1977 21 p refs

(Contract EC-77-C-02-4434)
(COO-4434-1) Avail: NTIS HC A02/MF A01

The base-case (first-cut) flowsheet analysis for two thermochemical water-splitting cycles: a four-step iron chloride cycle (denoted B-1) and a four-step copper sulfate cycle (denoted H-5) was completed. In the case of Cycle B-1, an energy balance located the worst problem areas in the cycle, and flowsheet modifications were begun. Calculations of equilibrium effects due to the hydrolysis of ferrous chloride at pressures high enough to interface with projected hydrogen transmission systems will necessitate higher temperature process heat input for this step. Higher pressure operation of some critical separation processes yields more favorable heat balances. For Cycle H-5, the unmodified (base-case) flowsheet indicates that reaction product separations will be relatively simple with respect to Cycle B-1. Work dealing with the electrolysis and thermodynamics of HBr/H2O/SO2 systems is being extensively reviewed. ERA

N78-26234# Technological Lab. RVO-TNO, Rijswijk (Netherlands).
INVESTIGATIONS ON THE RELIABILITY OF SOLID ROCKET PROPELLANTS AND SOLID PROPELLANT ROCKET ENGINES. PART 12: DETERMINATION OF MECHANICAL PROPERTIES OF HOMOGENEOUS SOLID ROCKET PROPELLANT UNDER UNIAXIAL DRAWING AND COMPRESSION LOAD [BETROUWBAARHEIDSONDERZOEK VAN RAKETKRUIT EN RAKETMOTOREN. TWAALFDE DEELVERSLAG: BEPALLING VAN MECHANISCHE EIGENSCHAPPEN VAN HOMOGEEN RAKETKRUIT BIJ UNIAXIALE TREK- EN KOMPRESSIE BELASTING]
P. J. Greidanus 9 Feb. 1977 37 p refs In DUTCH; ENGLISH summary
(Contract A64/KL/097)
(TL-1977-4; TDCK-69246) Avail: NTIS HC A03/MF A01

For the investigation into the reliability of solid rocket propellants and solid propellant rocket motors, a uniaxial compression technique was evaluated. In contrast with tensile testing the uniaxial compression test is simple, quick, and requires little labor and only a small quantity of test material per experiment. Uniaxial compression will be very suitable as a test method in routine work and comparative investigations such as product control and surveillance testing, the more so because the data do not result in specific mechanical properties of the material, as Young's modulus and failure criteria. The influence of moisture, strain rate, temperature, location of sample in grain, and sample dimensions on several mechanical properties of N-4 propellant were determined. The tensile failure strain of N-4 propellant differs more than 15% from the theoretical value, calculated from uniaxial compression data. Author (ESA)

N78-26235# Technological Lab. RVO-TNO, Rijswijk (Netherlands).
INVESTIGATION ON THE RELIABILITY OF SOLID ROCKET PROPELLANTS AND SOLID PROPELLANT ROCKET ENGINES. PART 13: APPLICATION AND EVALUATION OF THE ANDREX X-RAY APPARATUS MODEL 1541 BW [BETROUWBAARHEIDSONDERZOEK VAN RAKETKRUIT EN RAKETMOTOREN. DERTIENDE DEELVERSLAG: TOEPASSING EN EVALUATIE VAN HET ANDREX ROENTGENAPPARAAT MODEL 1541 BW]
J. Keijzer 21 Feb. 1977 27 p refs In DUTCH; ENGLISH summary
(Contract A64/KL/097)
(TL-1977-5; TDCK-69247) Avail: NTIS HC A03/MF A01

The Andrex X-ray apparatus model 1541 BW was evaluated with respect to the nondestructive testing of rocket engines, propellant powders and explosives. The printed radiographs clearly illustrate that the X-ray apparatus provides adequate information in the fields mentioned. ESA

31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; and cryogenics.

N78-26236 Virginia Polytechnic Inst. and State Univ., Blacksburg.
MEASUREMENT OF SIMULTANEOUS FLUCTUATING LOADS AT MULTIPLE LEVELS ON A MODEL OF A TALL BUILDING IN A SIMULATED URBAN BOUNDARY LAYER Ph.D. Thesis
Timothy Allen Reinhold 1977 219 p
Avail: Univ. Microfilms Order No. 78-07222

Wind tunnel tests were conducted in an effort to determine the magnitudes, power spectra, and correlation of loads over the surface of a model of a tall building. The model was tested as a single element and also with an identical element upstream to provide an interfering flow. Work is presented in three parts which deal with the boundary layer simulation, the measurement technique using multiple transducers and the results of several model tests. Results indicate that the placement and orientation of neighboring buildings is critical to the aerodynamic stability of a particular building. Dissert. Abstr.

N78-26237# General Motors Research Labs., Warren, Mich.
A COLLECTION OF STIRLING ENGINE REPORTS FROM GENERAL MOTORS' RESEARCH, 1958 TO 1970. PART 1.1: MODEL 3 GROUND POWER UNITS DESIGN, CONSTRUCTION AND TESTING. GOVERNMENT CONTRACT REPORTS
Apr. 1978 184 p
(GMR-2690-Pt-1.1) Avail: NTIS HC A09/MF A01

Numerous progress reports concerning the performance of the Stirling ground power unit are presented. Acceptance tests results are included as well as an instruction manual and a listing of parts. For individual titles, see N78-26238 through N78-26249.

N78-26238# General Motors Research Labs., Warren, Mich.
STIRLING ENGINE GROUND POWER UNIT Quarterly Report, 17 Jun. - 17 Sep. 1963 c37
F. Earl Heffner *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 1.1: Model 3 Ground Power Units Design, Construct. and Testing. Govt. Contract Rept. Apr. 1978 6 p (For availability see N78-26237 17-31)
(Contract DA-44-009-AMC-250(T))
(GMR-2690-Sect-1.101; QR-1) Avail: NTIS HC A09/MF A01

Progress for the delivery of two ground power units (GPU) is reported. Army experiences with the GPU were reviewed and an outline of proposed work was provided. B.B.

N78-26239# General Motors Research Labs., Warren, Mich.
STIRLING ENGINE GROUND POWER UNIT Quarterly Report, 18 Sep. - 17 Dec. 1963 c37
F. Earl Heffner *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 1.1: Model 3 Ground Power Units Design, Construct. and Testing. Govt. Contract Rept. Apr. 1978 17 p (For availability see N78-26237 17-31)
(Contract DA-44-009-AMC-250(T))
(GMR-2690-Sect-1.102; QR-2) Avail: NTIS HC A09/MF A01

Package noise and environmental effects are reported in some detail. B.B.

N78-26240# General Motors Research Labs., Warren, Mich.
STIRLING ENGINE GROUND POWER UNIT Quarterly Report, 18 Dec. 1963 - 17 Mar. 1964 c37
F. Earl Heffner *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 1.1: Model 3 Ground Power Units Design, Construct. and Testing. Govt. Contract Rept. Apr. 1978 10 p (For availability see N78-26237 17-31)
(Contract DA-44-009-AMC-250(T))
(GMR-2690-Sect-1.103; QR-3) Avail: NTIS HC A09/MF A01

Progress of the programs conducted in relation to the Stirling engine ground power units is reviewed. Design of the engine and accessory systems was studied in detail. B.B.

N78-26241# General Motors Research Labs., Warren, Mich.
STIRLING ENGINE GROUND POWER UNIT Quarterly Progress Report, 18 Mar. - 17 Jun. 1964 c37
F. Earl Heffner *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 1.1: Model 3 Ground Power Units Design, Construct. and Testing. Govt. Contract Rept. Apr. 1978 5 p (For availability see N78-26237 17-31)

(Contract DA-44-009-AMC-250(T))
(GMR-2690-Sect-1.104; QPR-4) Avail: NTIS HC A09/MF A01
For abstract, see N78-26237.

N78-26242# General Motors Research Labs., Warren, Mich.
STIRLING ENGINE GROUND UNIT Quarterly Progress Report, 18 Jun. - 17 Sept. 1964 **c37**
F. Earl Heffner *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 1.1: Model 3 Ground Power Units Design, Construct. and Testing. Govt. Contract Rept. Apr. 1978 6 p (For availability see N78-26237 17-31)
(Contract DA-44-009-AMC-250(T))
(GMR-2690-Sect-1.105; QPR-5) Avail: NTIS HC A09/MF A01

The potential aural advantage in the use of a single crankshaft engine in place of the rhombic drive which requires timing gears was indicated. Experimental and design programs were pursued to evaluate the consequences of building a package sufficiently impervious to deflection and vibration to permit successful operation of the single crankshaft machine for the required 500 hours. Criteria were established for governor components and package inertia which will permit attainment of governing target specifications. B.B.

N78-26243# General Motors Research Labs., Warren, Mich.
STIRLING ENGINE GROUND POWER UNIT Quarterly Progress Report, 18 Sep. 1964 - 31 Jan. 1965 **c37**
F. Earl Heffner *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 1.1: Model 3 Ground Power Units Design, Construct. and Testing. Govt. Contract Rept. Apr. 1978 11 p (For availability see N78-26237 17-31)
(Contract DA-44-009-AMC-250(T))
(GMR-2690-Sect-1.106; QPR-6) Avail: NTIS HC A09/MF A01

A comparison was made between the usual Stirling rhombic drive and a more conventional single crank mechanism to determine whether the vibration of the inherently unbalanced single crank machine would produce more noise than the timing gears of the rhombic drive. On the basis of the tests performed, it was determined that the rhombic drive machine would more probably produce a quieter GPU than would the single crank machine within the limitations of the further time allowed for development work. B.B.

N78-26244# General Motors Research Labs., Warren, Mich.
STIRLING ENGINE GROUND POWER UNIT Quarterly Progress Report, 1 Feb. - 30 Apr. 1965 **c37**
F. Earl Heffner *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 1.1: Model 3 Ground Power Units Design, Construct. and Testing. Govt. Contract Rept. Apr. 1978 6 p (For availability see N78-26237 17-31)
(Contract DA-44-009-AMC-250(T))
(GMR-2690-Sect-1.107; QPR-7) Avail: NTIS HC A09/MF A01

A preheater core with improvements based upon experience with Stirling preheaters was incorporated into an assembly design matched to the GPU 3 requirements. Several piston seal configurations were tested beyond 500 hours in test fixtures duplicating operating conditions. B.B.

N78-26245# General Motors Research Labs., Warren, Mich.
STIRLING ENGINE GROUND POWER UNIT Quarterly Progress Report, 1 May - 31 Jul. 1965 **c37**
F. Earl Heffner *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 1.1: Model 3 Ground Power Units Design, Construct. and Testing. Govt. Contract Rept. Apr. 1978 12 p (For availability see N78-26237 17-31)
(Contract DA-44-009-AMC-250(T))
(GMR-2690-Sect-1.108; QPR-8) Avail: NTIS HC A09/MF A01

Progress toward the construction of two Stirling ground units to be delivered to the U.S. Army is reviewed. The major elements of the manual starting system for the GPU 3's were built and tested to show their complete feasibility. The final requirements for the crankcase were established by extensive governor and prototype engine generator testing. B.B.

N78-26246# General Motors Research Labs., Warren, Mich.
STIRLING ENGINE GROUND POWER UNIT Final Progress Report, 1 Aug. 1965 - 15 Apr. 1966 **c37**
F. Earl Heffner *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 1.1: Model 3 Ground Power Units Design, Construct. and Testing. Govt. Contract Rept. Apr. 1978 10 p (For availability see N78-26237 17-31)
(Contract DA-44-009-AMC-250(T))
(GMR-2690-Sect-1.109) Avail: NTIS HC A09/MF A01

A discussion of the actual design objectives of the GPU 3 is presented and the important characteristics of the resulting Stirling engine ground power units were summarized. B.B.

N78-26247# General Motors Research Labs., Warren, Mich.
STIRLING ENGINE GROUND POWER UNIT MODEL GPU 3 ACCEPTANCE TEST REPORT **c37**
F. Earl Heffner *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 1.1: Model 3 Ground Power Units Design, Construct. and Testing. Govt. Contract Rept. Apr. 1978 19 p (For availability see N78-26237 17-31)
(GMR-2690-Sect-1.110) Avail: NTIS HC A09/MF A01

A discussion of the acceptance tests conducted prior to the delivery of the Stirling engines, is presented and certain required graphic plots of data from those tests are included. B.B.

N78-26248# General Motors Research Labs., Warren, Mich.
MANUAL AND PARTS LIST FOR STIRLING GROUND POWER UNITS, MODEL GPU-3 **c37**
F. Earl Heffner, Raymond M. Cole, and Richard R. Toepel *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 1.1: Model 3 Ground Power Units Design, Construct. and Testing. Govt. Contract Rept. Apr. 1978 53 p (For availability see N78-26237 17-31)
(Contract DA-44-009-AMC-250(T))
(GMR-2690-Sect-1.111) Avail: NTIS HC A09/MF A01

Operating, maintenance, and repair instructions; were provided as well as a parts list; installation drawings pertaining to two Stirling engine GPU 3's. Detailed discussions of the operation of all GPU 3 accessory and control systems are also presented. B.B.

N78-26249# General Motors Research Labs., Warren, Mich.
US ARMY ENGINEER RESEARCH AND DEVELOPMENT LABORATORIES FIVE HUNDRED HOUR ENGINEERING EVALUATION OF THE STIRLING GPU 2-1 **c37**
F. Earl Heffner *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 1.1: Model 3 Ground Power Units Design, Construct. and Testing. Govt. Contract Rept. Apr. 1978 24 p (For availability see N78-26237 17-31)
(GMR-2690-Sect-1.112) Avail: NTIS HC A09/MF A01

The performance of the Stirling ground power unit during the Army 500 hour engineering evaluation is discussed, and the results of a post-test inspection are presented. B.B.

N78-26250# General Motors Research Labs., Warren, Mich.
A COLLECTION OF STIRLING ENGINE REPORTS FROM GENERAL MOTORS' RESEARCH, 1958 TO 1970. PART 1.2: MODEL 3 GROUND POWER UNITS DESIGN, CONSTRUCTION, AND TESTING, GENERAL MOTORS RESEARCH STUDIES
Apr. 1978 266 p refs
(GMR-2690-Pt-1.2) Avail: NTIS HC A12/MF A01

The design, production, and performance of a prototype Stirling engine ground power unit are described, as well as uniform test procedures and component reliability. For individual titles, see N78-26251 through N78-26261.

N78-26251# General Motors Research Labs., Warren, Mich.
EFFECT OF DIESEL FUEL ON STIRLING ENGINE GROUND POWER UNIT COMPONENTS **c37**
Richard R. Toepel *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 1.2: Model 3 Ground Power Units Design, Construct., and Testing, Gen. Motors Res. Studies Apr. 1978 9 p refs (For availability see N78-26250 17-31)
(GMR-2690-Sect-1.201) Avail: NTIS HC A12/MF A01

The effects of several types of diesel fuel on nitrile, neoprene, and vitron compounds as related to components of the Stirling

engine ground power unit are compared. Results of fuel analysis and elastomer immersion tests are presented. Recommendations are made for elastomer specifications. A.R.H.

N78-26252# General Motors Research Labs., Warren, Mich.
MANUAL CRANKING TESTS OF THE STIRLING ENGINE GROUND POWER UNIT **c37**
Richard R. Toepel *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 1.2: Model 3 Ground Power Units Design, Construct., and Testing, Gen. Motors Res. Studies Apr. 1978 14 p (For availability see N78-26250 17-31)
(GMR-2690-Sect-1.202) Avail: NTIS HC A12/MF A01

Starting tests were conducted on the Stirling engine ground power unit (GPU 2-2) to determine the input energy requirements over a range of engine working pressures and to judge the suitability of several manual cranking systems for use on the GPU-3. The manual systems tested were (1) spring, (2) dead-weight, and (3) hand-type. The spring cranking tests were conducted at various package moment of inertias from 125 to 500 lb-sq in. The dead-weight and hand-type tests were conducted at an inertia value of 500 lb-sq in. Input energy requirements were found to vary directly with engine working pressure and to be independent of engine inertia. The hand-type starts using a cable and pulley arrangement were found to provide an excess of input energy over the minimum requirements; therefore, this system was recommended for use on the GPU-3. Author

N78-26253# General Motors Research Labs., Warren, Mich.
THE GPU-3 STIRLING ENGINE GROUND POWER UNIT IGNITION SYSTEM **c37**
Richard R. Toepel *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 1.2: Model 3 Ground Power Units Design, Construct., and Testing, Gen. Motors Res. Studies Apr. 1978 9 p (For availability see N78-26250 17-31)
(GMR-2690-Sect-1.203) Avail: NTIS HC A12/MF A01

The ignition system for the GPU-3 Stirling ground power unit requires compatibility with the manual starting requirements of the package, as well as less input power than previous systems because of necessary limits on total accessory input power for the manual method of starting. A system was developed consisting of a permanent magnet ac generator and an ac input exciter unit coupled to an ignitor plug. Tests were conducted on purchased sets of alternators and exciters to determine spark rate and alternator input torque. A.R.H.

N78-26254# General Motors Research Labs., Warren, Mich.
COMBUSTOR DEVELOPMENT FOR STIRLING GROUND POWER UNITS, GPU-2 AND GPU-3 **c37**
Robert E. Sullivan *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 1.2: Model 3 Ground Power Units Design, Construct., and Testing, Gen. Motors Res. Studies Apr. 1978 53 p ref (For availability see N78-26250 17-31)
(GMR-2690-Sect-1.204) Avail: NTIS HC A12/MF A01

The design and development of continuous combustion systems for the GPU-2 and GPU-3 Stirling engine ground power units are described. Durability aspects of the GPU-2 burner and modifications to appreciably extend the endurance life of the combustion parts are discussed as well as the GPU-3 burner configuration which evolved as a result of the GPU-2 burner experience. The improved GPU-3 burner demonstrated good durability for operating time in excess of 1000 hours, reliable ignition, and smokeless operation during engine warm up. Combustion systems deviating in design and operating principles from conventional gas turbine practice were assessed such as burners having alternate wall cooling techniques and novel internal flow schemes. The merits and limitations of these configurations are reported. A.R.H.

N78-26255# General Motors Research Labs., Warren, Mich.
THE EFFECT OF A BYPASS VALVE ON STIRLING ENGINE BRAKING ABILITY **c37**
Robert J. Bayer *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 1.2: Model 3 Ground Power Units Design, Construct., and Testing, Gen. Motors Res. Studies Apr. 1978 25 p (For availability see N78-26250 17-31)
(GMR-2690-Sect-1.205) Avail: NTIS HC A12/MF A01

The capability of the Stirling engine for power absorption for braking was demonstrated by placing a bypass valve between the working space and the buffer space in a 10 hp single cylinder Stirling engine. A braking power equal to 88% of the normal full load output of the engine was achieved. When bypassing and absorbing 88% of full load power, the fuel rate and the heat rejected to the coolants were respectively 76% and 133% of the normal full load quantities. A.R.H.

N78-26256# General Motors Research Labs., Warren, Mich.
PRELIMINARY PERFORMANCE TESTS OF A GPU-3 STIRLING ENGINE ON HYDROGEN, HELIUM, AND NITROGEN **c37**
James E. Bennethum *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 1.2: Model 3 Ground Power Units Design, Construct., and Testing, Gen. Motors Res. Studies Apr. 1978 14 p (For availability see N78-26250 17-31)
(GMR-2690-Sect-1.206) Avail: NTIS HC A12/MF A01

The GPU-3 Stirling thermal engine was found to have poor performance when helium was used as the working gas. Preliminary tests indicate that the problem involves low heater tube wall temperatures and additional friction losses resulting from the operation of the rulon piston rings in the helium filled cylinder. Several deviations from the predictions generated by the Stirling engine analysis program were found and more testing is required after the addition of more instrumentation on the engine cylinder and the installation of a heater manifold and external preheater to obtain more accurate measurements. A.R.H.

N78-26257# General Motors Research Labs., Warren, Mich.
STIR-LEC 2 STIRLINC ENGINE PERFORMANCE **c37**
Richard R. Toepel *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 1.2: Model 3 Ground Power Units Design, Construct., and Testing, Gen. Motors Res. Studies Apr. 1978 5 p ref (For availability see N78-26250 17-31)
(GMR-2690-Sect-1.207) Avail: NTIS HC A12/MF A01

Prior to its installation in the Stir-Lec hybrid vehicle, a Stirling engine weighing 57 pounds less than the original one was dynamometer tested to establish its performance. Three speed levels, four pressure levels, and three water temperature levels were run in a factorial plan so that 12 runs of a possible 36 combinations were made. Results of the 12 runs are tabulated for horsepower output, fuel consumption, and compression space temperature. Complete calculations for the 36 combinations are included. A.R.H.

N78-26258# General Motors Research Labs., Warren, Mich.
METHOD OF TESTS AND INSTRUCTIONS (GENERATOR SETS, STIRLING ENGINE DRIVE) **c37**
Raymond M. Cole *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 1.2: Model 3 Ground Power Units Design, Construction, and Testing, Gen. Motors Res. Studies Apr. 1978 37 p (For availability see N78-26250 17-31)
(GMR-2690-Sect-1.208) Avail: NTIS HC A12/MF A01

Military tests for gasoline or diesel engines (MIL-STD-1400) and for engine driven gasoline sets (MIL-STD-705A) were adapted for use in the uniform testing of Stirling engines. Qualification tests presented include: initial inspection; check test and run in; initial performance; ideal idle to full-load characteristics; actual idle to full load characteristics; maximum power; governor stability and transient response; governor droop characteristics; endurance tests; final performance; and final inspection. Because the ground power unit does not represent a production prototype, environmental testing procedures were not included. A.R.H.

N78-26259# General Motors Research Labs., Warren, Mich.
GPU 3-3 PROTOTYPE PRODUCT DEMONSTRATION TESTS **c37**
Raymond M. Cole and Kenneth J. Stukas *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 1.2: Model 3 Ground Power Units Design, Construct., and Testing, Gen. Motors Res. Studies Apr. 1978 57 p refs (For availability see N78-26250 17-31)

(GMR-2690-Sect-1.209) Avail: NTIS HC A12/MF A01

A series of tests, equal in severity to Military Standards Tests, were performed over a one year period on a Stirling engine generator set. The GPU 3-3 generator set successfully demonstrated a durability of 500 hours, limited principally by deficiencies in the speed control system and hydrogen compressor, while all major engine components have indicated lives well in excess of 2000 hours. Comments and photographs resulting from the final inspection are included. A.R.H.

N78-26260# General Motors Research Labs., Warren, Mich.
STIRLING ENGINE TESTS SIMULATING UNDERWATER TES OPERATION **c37**
John H. Lienesch *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 1.2: Model 3 Ground Power Units Design, Construct., and Testing, Gen. Motors Res. Studies Apr. 1978 12 p ref (For availability see N78-26250 17-31)
(GMR-2690-Sect-1.210) Avail: NTIS HC A12/MF A01

A Stirling engine was tested under operating conditions similar to those expected for underwater applications using a thermal energy storage (TES) heat source. Engine performance maps at full pressure are given for both a standard cylinder and a long cooler cylinder and compared to predictions. The data indicates that the standard cylinder makes more power, but the long cooler cylinder operates at a higher thermal efficiency. A.R.H.

N78-26261# General Motors Research Labs., Warren, Mich.
FINAL SURVEY OF STIRLING ENGINE COMPONENT DURABILITY **c38**
Raymond M. Cole *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 1.2: Model 3 Ground Power Units Design, Construc., and Testing, Gen. Motors Res. Studies Apr. 1978 26 p refs (For availability see N78-26250 17-31)
(GMR-2690-Sect-1.211) Avail: NTIS HC A12/MF A01

The total running time in excess of 1000 hours accumulated by more than 326 critical parts of the experimental 10 HP Stirling engines which were operated during the years between 1959 and termination of the project in 1970 are documented. It seems justifiable to conclude that all major components have useful lives in excess of 2000 hours. A.R.H.

N78-26262# General Motors Research Labs., Warren, Mich.
A COLLECTION OF STIRLING ENGINE REPORTS FROM GENERAL MOTORS' RESEARCH, 1958 TO 1970. PART 2: STIRLING CYCLE ANALYSIS AND ENGINE DESIGN STUDIES
Apr. 1978 315 p refs
(GMR-2690-Pt-2) Avail: NTIS HC A14/MF A01

Computerized design studies on Stirling cycle thermal engines for automotive applications are reported. For individual titles, see N78-26263 through N78-26283.

N78-26263# General Motors Research Labs., Warren, Mich.
AN ANALYTICAL TREATMENT OF THE STIRLING CYCLE ENGINE **c37**
John R. Altenhoff, Richard L. Justice, and Donald R. Olson *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 2: Stirling Cycle Anal. and Eng. Design Studies Apr. 1978 19 p (For availability see N78-26262 17-31)
(GMR-2690-Sect-2.101) Avail: NTIS HC A14/MF A01

Trigonometric relationships which simulate the kinematics of the engine are used to describe the variation of the working volumes. Ordinary differential equations for the pressure and mass resulted from the energy balance for the control volumes. Two partial differential equations were developed that depict solid and fluid temperature distributions in the regenerator. These equations were then supplemented by other thermodynamic, fluid flow, and heat transfer relationships. Due to the oscillating fluid flow in the engine, two distinct sets of equations were derived. One describes flow from the hot to the cold volume while the other describes flow in the opposite direction. G.G.

N78-26264# General Motors Research Labs., Warren, Mich.
DIGITAL COMPUTER PROGRAM FOR SIMULATION OF A STIRLING CYCLE ENGINE **c61**
John R. Altenhoff *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 2: Stirling Cycle Anal. and Eng. Design Studies Apr. 1978 21 p (For availability see N78-26262 17-31)
(GMR-2690-Sect-2.102) Avail: NTIS HC A14/MF A01

The IBM 704 digital computer program is described that was used to solve the equations formulated in the analysis of a Stirling cycle engine. Included are a program flow chart and a copy of the program which is functional in its present state. G.G.

N78-26265# General Motors Research Labs., Warren, Mich.
STIRLING CYCLE ENGINE PARAMETER STUDY **c37**
Richard L. Justice *In its* A collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 2: Stirling Cycle Anal. and Eng. Design Studies Apr. 1978 8 p (For availability see N78-26262 17-31)
(GMR-2690-Sect-2.103) Avail: NTIS HC A14/MF A01

The IBM 704 computer study of the model 10-36 Stirling cycle engine indicates design change effects and checks this particular computer simulation of an actual engine. Principle parameters investigated include: cooler wall temperatures; mean pressure; engine speed; heater wall temperature; regenerator porosity; regenerator length; heater tube diameter; cooler tube diameter; bore to stroke ratio; working medium; and film coefficient relationship. G.G.

N78-26266# General Motors Research Labs., Warren, Mich.
MATHEMATICAL MODEL OF THE STIRLING THERMAL ENGINE **c64**
Richard L. Justice and James E. Bennethum *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 2: Stirling Cycle Anal. and Eng. Design Studies Apr. 1978 7 p (For availability see N78-26262 17-31)
(GMR-2690-Sect-2.104) Avail: NTIS HC A14/MF A01

The Stirling thermal engine is thermodynamically described as a closed system made up of a number of open sub-systems joined together in series so that the entire internal volume of the engine is considered as one system with no mass crossing the system boundaries; only energy in the form of heat or work was included. G.G.

N78-26267# General Motors Research Labs., Warren, Mich.
AN ITERATIVE-FINITE DIFFERENCE SOLUTION OF THE DIFFERENTIAL EQUATIONS DESCRIBING THE STIRLING THERMAL ENGINE **c64**
James E. Bennethum *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 2: Stirling Cycle Anal. and Eng. Design Studies Apr. 1978 13 p (For availability see N78-26262 17-31)
(GMR-2690-Sect-2.105) Avail: NTIS HC A14/MF A01

A finite difference-iteration technique is used to analyze the operation of a Stirling thermal engine. The engine was divided into five separate sub-systems each of which was associated with one of the five physical elements in the engine. A set of initial conditions was assumed and the solution proceeded by stepping forward in time, each time step being related to a fixed part of the total crank rotation for one engine cycle. An iteration procedure was employed to increase the accuracy of the solution at each time step. Computed values were utilized to obtain new initial conditions until the variables at the begining and end of the iteration fell within some allowable limit. Final cycle conditions were checked against initial conditions and the entire calculation was repeated until satisfactory agreement was reached. G.G.

N78-26268# General Motors Research Labs., Warren, Mich.
NUMERICAL TREATMENT OF A THIRD ORDER NONLINEAR HYPERBOLIC DIFFERENTIAL SYSTEM **c64**
Richard L. Justice *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 - 1970. Pt. 2: Stirling Cycle Anal. and Eng. Design Studies Apr. 1978 7 p refs (For availability see N78-26262 17-31)
(GMR-2690-Sect-2.106) Avail: NTIS HC A14/MF A01

The differential equations describing the Stirling cycle engine are discussed as to techniques of solution available and the relative difficulties connected with obtaining some refined solution. Author

N78-26269# General Motors Research Labs., Warren, Mich.
FORMULAE FOR THE THERMODYNAMIC PROPERTIES OF NORMAL MOLECULAR HYDROGEN **c72**
W. J. Gordon and R. Hickling *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 2: Stirling Cycle Anal. and Eng. Design Studies Apr. 1978 16 p refs (For availability see N78-26262 17-31)
(GMR-2690-Sect-2.107) Avail: NTIS HC A14/MF A01

Hydrogen is often used as the working fluid in the Stirling cycle engine. Accurate and complete formulas for the thermodynamic properties of normal hydrogen are developed that are suitable for use on a high speed computer. G.G.

N78-26270# General Motors Research Labs., Warren, Mich.
THE EVOLUTION OF A PRACTICAL ENGINE FROM THE IDEAL STIRLING CYCLE AND THE RESULTING LOSSES **c37**
James E. Bennethum *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 2: Stirling Cycle Anal. and Eng. Design Studies Apr. 1978 13 p (For availability see N78-26262 17-31)
(GMR-2690-Sect-2.108) Avail: NTIS HC A14/MF A01

The basic Stirling cycle is described and some of the shortcomings of the practical Stirling engine are discussed. G.G.

N78-26271# General Motors Research Labs., Warren, Mich.
SOME COMMENTS ON THE EXTERNAL COMBUSTION ENGINE **c25**
James E. Bennethum *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 2: Stirling Cycle Anal. and Eng. Design Studies Apr. 1978 5 p (For availability see N78-26262 17-31)
(GMR-2690-Sect-2.109) Avail: NTIS HC A14/MF A01

The external heat transfer of the engine heater, the maximum allowable heater tube wall temperature, and preheater effectiveness are closely related quantities which determine the burner inlet temperature and the allowable overall efficiency of this external combustion system. Under optimum operating conditions, at low mass flow rates, dissociation of combustion products becomes a significant factor and causes drastic changes in the energy exchange pattern. Radiant heat transfer from a luminous flame to the heater serves to offset the influence of dissociation in some burners. G.G.

N78-26272# General Motors Research Labs., Warren, Mich.
FACTORS INFLUENCING THE EVALUATION OF AN EXTERNAL HEAT TRANSFER COEFFICIENT TO BE APPLIED TO STIRLING ENGINE HEATERS **c34**
James E. Bennethum *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 2: Stirling Cycle Anal. and Eng. Design Studies Apr. 1978 8 p refs (For availability see N78-26262 17-31)
(GMR-2690-Sect-2.110) Avail: NTIS HC A14/MF A01

The influence of gas flow, large temperature gradients, and gas dissociation on the heat transfer from combustion gases to tube banks is discussed. Some general conclusions concerning Stirling engine heater design are presented. Author

N78-26273# General Motors Research Labs., Warren, Mich.
A COMPARISON OF THE CALCULATED AND MEASURED INFLUENCE OF LONG CONNECTING DUCTS ON STIRLING ENGINE PERFORMANCE **c37**
James E. Bennethum *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 2: Stirling Cycle Anal. and Eng. Design Studies Apr. 1978 6 p ref (For availability see N78-26262 17-31)
(GMR-2690-Sect-2.111) Avail: NTIS HC A14/MF A01

The new double acting Stirling engine design uses long cold ducts to make the necessary connection between cyclic working spaces. This was taken into consideration in the computer analysis. Special tests were run on a standard GPU-3 engine and the results show that the analysis adequately assesses the changes brought about by increasing the connecting duct length. G.G.

N78-26274# General Motors Research Labs., Warren, Mich.
DETERMINATION OF COOLER FILM COEFFICIENTS FOR THE GPU-2 STIRLING ENGINE **c34**
Stanley Nylund *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 2: Stirling Cycle Anal. and Eng. Design Studies Apr. 1978 14 p (For availability see N78-26262 17-31)
(GMR-2690-Sect-2.112) Avail: NTIS HC A14/MF A01

Film coefficients were determined experimentally as well as analytically for GPU-2 cooler bundles. The results are compared, and a correction is applied. A test was also carried out in which film coefficients were compared for the following cooler tube conditions: (1) Cooler tubes clean, not deburred; (2) cooler tubes clean, deburred; and (3) cooler tubes with oil film, deburred. Author

N78-26275# General Motors Research Labs., Warren, Mich.
AN EVALUATION OF STIRLING ENGINE COOLER ANALYSIS AND DESIGN **c34**
James E. Bennethum *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 2: Stirling Cycle Anal. and Eng. Design Studies Apr. 1978 10 p ref (For availability see N78-26262 17-31)
(GMR-2690-Sect-2.113) Avail: NTIS HC A14/MF A01

Comparison of the measured and predicted performance of a Stirling engine resulted in uncovering a fundamental error in the engine analysis. It also brought out the difficulties associated with assigning a particular set of computer results to a given engine operating point. Modifications in the GMR computer program have taken care of both of these problems and make it possible to show the important part that engine cooler design plays in the actual performance of the engine. Author

N78-26276# General Motors Research Labs., Warren, Mich.
THE ENTHALPY FLUX LOSS THROUGH A STIRLING CYCLE REGENERATOR WITH THE FLOW RESISTANCE SATISFYING DARCY'S LAW **c77**
Robert Hickling *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 2: Stirling Cycle Anal. and Eng. Design Studies Apr. 1978 6 p refs (For availability see N78-26262 17-31)
(GMR-2690-Sect-2.114) Avail: NTIS HC A14/MF A01

A formula for loss is reported assuming that the gas is perfect and that the flow resistance satisfies Darcy's Law for flow through porous media. The formula is derived from simple considerations of mass and energy conservation and relates the enthalpy flux loss to the pressure variations at the ends of the regenerator. G.G.

N78-26277# General Motors Research Labs., Warren, Mich.
CALCULATED 4L23 STIRLING ENGINE PERFORMANCE **c37**
Robbert Diepenhorst *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 2: Stirling Cycle Anal. and Eng. Design Studies Apr. 1978 19 p (For availability see N78-26262 17-31)
(GMR-2690-Sect-2.115) Avail: NTIS HC A14/MF A01

Performance curves are presented that were calculated with the Stirling engine analytical computer program over a wide range of operating conditions. With coolant, oil and heater temperatures simulating a vehicular installation, the calculated output and efficiency at design speed (2000 rpm) and design pressure (1500 psia) are 129.5 BHP and 31.3%, respectively. G.G.

N78-26278# General Motors Research Labs., Warren, Mich.
CALCULATED ENGINE PERFORMANCE AND PERFORMANCE CORRECTION CURVES FOR MODELS GPU-3, 30-15, 80-15 AND 4L23 STIRLING ENGINES **c37**
Robbert Diepenhorst and Charles W. Cooper *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 2: Stirling Cycle Anal. and Eng. Design Studies Apr. 1978 38 p (For availability see N78-26262 17-31)
(GMR-2690-Sect-2.116) Avail: NTIS HC A14/MF A01

The Stirling engine computer program was used to calculate performance and hot and cold end temperature correction curves for four Stirling engines over a wide range of operating conditions. These engines randed in size from a single cylinder rhombic drive engine of 10 BHP output up to a four cylinder double acting engine of 130 BHP. G.G.

N78-26279# General Motors Research Labs., Warren, Mich.
STUDY OF STIRLING ENGINE HEAT SOURCES 1: HEATING SYSTEM ENERGY BALANCE **c77**
John C. Steiner *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 2: Stirling Cycle Anal. and Eng. Design Studies Apr. 1978 18 p (For availability see N78-26262 17-31)
(GMR-2690-Sect-2.201) Avail: NTIS HC A14/MF A01

Combustion gas temperatures at the heater inlet and outlet are presented as functions of the fuel rate. Each figure shows these temperatures at six air-to-fuel ratios for a particular preheater efficiency. Five preheater efficiencies from 75% to 95% are considered in the five figures. G.G.

N78-26280# General Motors Research Labs., Warren, Mich.
STUDY OF STIRLING ENGINE HEAT SOURCES 2: OPTIMUM PLAIN TUBE ENGINE HEATER DESIGNS **c77**
John C. Steiner *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 2: Stirling Cycle Anal. and Eng. Design Studies Apr. 1978 30 p (For availability see N78-26262 17-31)
(GMR-2690-Sect-2.202) Avail: NTIS HC A14/MF A01

The overall efficiency of the Stirling engine is the product of thermodynamic and mechanical efficiencies of the engine itself and the efficiency of the external heat source. Various designs for a plain tube engine heater were evaluated in order to determine the heater configuration which yields the smallest internal volume while maintaining a high overall efficiency of the external heating system at the required total heat flow rate to the engine. Results indicate that a smaller internal volume is obtained if small tube diameters, close spacing, and multiple rows of tubes are specified in the heater design. G.G.

N78-26281# General Motors Research Labs., Warren, Mich.
OPTIMIZATION OF COOLER GEOMETRY FOR 10-36 STIRLING ENGINE **c34**
James E. Bennethum *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 2: Stirling Cycle Anal. and Eng. Design Studies Apr. 1978 12 p (For availability see N78-26262 17-31)
(GMR-2690-Sect-2.203) Avail: NTIS HC A14/MF A01

A gas-to-liquid heat exchanger is studied that consists of a series of tube bundles located in an annulus which encompasses the engine's cylinder liner. The gas passes back and forth through these tubes which connect the regenerator to the compression cylinder, exchanging heat with the cooling water as it does. Heat transfer and flow losses on the water side were considered in optimizing cooler geometry. Computations developed several cooler designs which have smaller internal volumes than the present 10-36 cooler. G.G.

N78-26282# General Motors Research Labs., Warren, Mich.
A SIMPLIFIED SIZE COMPARISON OF MULTI-CYLINDER STIRLING ENGINES WITH DIFFERENT DRIVE MECHANISMS **c37**
Robbert Diepenhorst *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 2: Stirling Cycle Anal. and Eng. Design Studies Apr. 1978 10 p (For availability see N78-26262 17-31)
(GMR-2690-Sect-2.204) Avail: NTIS HC A14/MF A01

A four cylinder engine design was analyzed with rhombic, swash plate and single crank drive mechanism. Figures were obtained indicating the relative crankcase size of each of the three drive mechanism that were considered. A four cylinder inline Stirling cycle engine with rhombic drive mechanism requires a crankcase 3.7 times larger than one having a swash plate or single crank drive mechanism. G.G.

N78-26283# General Motors Research Labs., Warren, Mich.
BASIC DESIGN OF THE MOST COMPACT STATE-OF-THE-ART STIRLING ENGINE **c37**
John H. Lienesch *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 2: Stirling Cycle Anal. and Eng. Design Studies Apr. 1978 29 p refs (For availability see N78-26262 17-31)
(GMR-2690-Sect-2.205) Avail: NTIS HC A14/MF A01

Of the three proposed double-acting engine designs considered, the in-line connecting rod engine holds the most promise for the future. Engines designed along slider crank principals are relatively easily converted to double pressure operation by overdesigning the bearings in the drive mechanism. The capability exists for running at double pressure with no increase in crankcase volume. The single crank design lies about midway between the swash plate and scotch yoke engines in power per unit volume with 22.8 hp/cu ft. G.G.

N78-26284# General Motors Research Labs., Warren, Mich.
A COLLECTION OF STIRLING ENGINE REPORTS FROM GENERAL MOTORS' RESEARCH, 1958 TO 1970. PART 3: STIRLING ENGINE MATERIALS AND STRESSES, 3.1 STIRLING ENGINE MATERIALS, 3.2 STIRLING ENGINE STRESSES
Apr. 1978 212 p
(GMR-2690-Pt-3) Avail: NTIS HC A10/MF A01

Failure and stress analyses of various engine parts and numerical and computer methods applicable to the evaluation of stresses and deformation in the Stirling engine are presented. Performance of materials selected for use in the engine is emphasized. For individual titles, see N78-26285 through N78-26298.

N78-26285# General Motors Research Labs., Warren, Mich.
STIRLING ENGINE HEATER TUBE FAILURES **c34**
John N. Johnson *In its* A Collection of Stirling Engine Reports from General Motors' Research, 1958 to 1970. Part 3: Stirling Engine Materials and Stresses, 3.1 Stirling Engine Materials, 3.2 Stirling Engine Stresses Apr. 1978 9 p (For availability see N78-26284 17-31)
(GMR-2690-Sect-3.101) Avail: NTIS HC A10/MF A01

The cause of leaks which had developed in the austenitic stainless steel heater tubes during operation was determined. It is concluded that: (1) the tube leaks were due to intergranular cracking of the tube wall, apparently resulting from a combination of high thermal stresses and grain boundary oxidation; (2) the severe grain boundary attack was associated with carbide precipitation and attendant depletion of chromium in the grain boundaries, producing localized regions of reduced oxidation resistance; and (3) appreciable intergranular oxidation was noted on the I.D., as well as the O.D., of the tubes, indicative of contamination of the hydrogen working gas. Use of a stabilized grade of stainless steel to reduce the incidence of intergranular oxidation is recommended. However, in view of the apparent high thermal stresses imposed on the tubes during operation, a material of greater high temperature strength than 310 stainless steel, such as N-155, is recommended for this application. J.M.S.

N78-26286# General Motors Research Labs., Warren, Mich.
STIRLING ENGINE HEATER TUBE FAILURE **c34**
John N. Johnson *In its* A Collection of Stirling Engine Reports from General Motors' Research, 1958 to 1970. Part 3: Stirling Engine Materials and Stresses, 3.1 Stirling Engine Materials, 3.2 Stirling Engine Stresses Apr. 1978 16 p (For availability see N78-26284 17-31)
(GMR-2690-Sect-3.102) Avail: NTIS HC A10/MF A01

Failure of a Stirling engine heater-cylinder assembly was examined. Failure occurred after 265 hours of operation under various conditions. Metallographic examination and electron probe microanalyses indicated the failure to be associated with extreme oxidation and carburization of the tube walls. The abnormal oxidation was attributed to the presence of copper on the tubes. A proprietary high temperature anti-seize compound used in assembly of the engine was judged to be the source of the copper. Carburizing exhaust gases produced at low air-fuel ratios and the presence of 'hot spots' on the tubes due to the abnormally heavy oxide scale was believed to be the cause of the carburization of the tubes. Copper was also detected in deposits obtained from three other heaters, not yet failed. J.M.S.

N78-26287# General Motors Research Labs., Warren, Mich.
STIRLING ENGINE POWER PISTONS SAE 4340 STEEL **c26**
Erwin R. Cprek *In its* A Collection of Stirling Engine Reports from General Motors' Research, 1958 to 1970. Part 3: Stirling Engine Materials and Stresses, 3.1 Stirling Engine Materials, 3.2 Stirling Engine Stresses Apr. 1978 6 p (For availability

see N78-26284 17-31)
(GMR-2690-Sect-3.103) Avail: NTIS HC A10/MF A01

Pistons which had failed due to gas leaks through a central threaded hole in the crown were submitted for examination. Inspection revealed that the gas leaks were due to fatigue cracks which had developed in the threads and progressed through the section. The presence of a coarse grained, heterogeneous structure indicated the part had not been heat treated following brazing. In addition to a section design modification it was recommended that the parts be air hardened and tempered after brazing to produce a fine grained, homogeneous structure. J.M.S.

N78-26288# General Motors Research Labs., Warren, Mich.
STIRLING ENGINE POWER PISTON SAE 4340 STEEL c26

Erwin R. Cprek *In its* A Collection of Stirling Engine Reports from General Motors' Research, 1958 to 1970. Part 3: Stirling Engine Materials and Stresses, 3.1 Stirling Engine Materials, 3.2 Stirling Engine Stresses Apr. 1978 7 p (For availability see N78-26284 17-31)
(GMR-2690-Sect-3.104) Avail: NTIS HC A10/MF A01

Gas leaks in several Stirling engine power pistons incorporating design and heat treatment practice modifications were investigated. Cause of the leakage, on the single piston examined, was found to be a fatigue crack in the interior section. Microscopic examination indicated that the interior portion of the piston had air cooled somewhat slower than the outer portion during the hardening treatment, resulting in an inferior microstructure. A group of seven pistons was, subsequently, heat treated, for testing, in a manner which provided uniform air cooling of the entire piston. Microstructure of these pistons, as determined by examination of a control sample, is considered satisfactory. J.M.S.

N78-26289# General Motors Research Labs., Warren, Mich.
EXAMINATION OF STIRLING ENGINE REGENERATOR SCREENS c37

J. E. Hunter and S. W. Iwankovitsch *In its* A Collection of Stirling Engine Reports from General Motors' Research, 1958 to 1970. Part 3: Stirling Engine Materials and Stresses, 3.1 Stirling Engine Materials, 3.2 Stirling Engine Stresses Apr. 1978 9 p refs (For availability see N78-26284 17-31)
(GMR-2690-Sect-3.105) Avail: NTIS HC A10/MF A01

Stacked 304 stainless steel screens, which comprise the heat exchanger surface of one type of Stirling engine regenerator, were found to be subject to local deterioration at the inlet tubes to the regenerator. The screens were examined to determine the cause for failure. Metallurgical examination indicated the inlet sides of the top screens were severely oxidized. Electron probe analysis confirmed this observation. Commercial dry hydrogen used as the working fluid, which may contain as much as 0.5 percent oxygen, is considered to be the most probable source of oxygen in the system. Use of purified hydrogen to eliminate oxidation of the screens and other parts is recommended. Use of nickel MetNet regenerators in the present atmosphere should also eliminate the regenerator oxidation. J.M.S.

N78-26290# General Motors Research Labs., Warren, Mich.
ALTERNATE MATERIALS FOR THE 4L23 STIRLING ENGINE c26

Frederick A. Robbins, II *In its* A Collection of Stirling Engine Reports from General Motors' Research, 1958 to 1970. Part 3: Stirling Engine Materials and Stresses, 3.1 Stirling Engine Materials, 3.2 Stirling Engine Stresses Apr. 1978 6 p (For availability see N78-26284 17-31)
(GMR-2690-Sect-3.106) Avail: NTIS HC A10/MF A01

Alternate materials, selected on a material performance basis, are presented for some of the 4L23 Stirling engine stainless steel and super alloy parts. Necessary properties of the material and the material presently used are included. J.M.S.

N78-26291# General Motors Research Labs., Warren, Mich.
A DERIVATION OF THE DESCRIBING EQUATIONS FOR A THIN ELASTIC SHELL OF REVOLUTION LOADED AXIALLY SYMMETRIC c39

Leland K. Shirley *In its* A Collection of Stirling Engine Reports from General Motors' Research, 1958 to 1970. Part 3: Stirling Engine Materials and Stresses, 3.1 Stirling Engine Materials, 3.2 Stirling Engine Stresses Apr. 1978 21 p (For availability see N78-26284 17-31)
(GMR-2690-Sect-3.201) Avail: NTIS HC A10/MF A01

The differential equations of thin elastic shells are derived in a form which is particularly amenable to numerical methods. The equations form a system of six simultaneous first order linear differential equations with variable coefficients. The problem with boundary conditions given at both ends of the shell is reduced to an equivalent problem in which all boundary conditions are given at one end. Special care is taken to present the assumptions made in the derivation. J.M.S.

N78-26292# General Motors Research Labs., Warren, Mich.
THE NUMERICAL INTEGRATION OF THE EQUATIONS WHICH DESCRIBE ELASTIC SHELLS c39

Leland K. Shirley *In its* A Collection of Stirling Engine Reports from General Motors' Research, 1958 to 1970. Part 3: Stirling Engine Materials and Stresses, 3.1 Stirling Engine Materials, 3.2 Stirling Engine Stresses Apr. 1978 18 p (For availability see N78-26284 17-31)
(GMR-2690-Sect-3.202) Avail: NTIS HC A10/MF A01

A computer program is described which gives numerical integrations of the equations of equilibrium of thin elastic shells. Author

N78-26293# General Motors Research Labs., Warren, Mich.
STRESS ANALYSIS OF THE DISPLACER CYLINDER OF THE 10-36 STIRLING ENGINE c39

Leland K. Shirley *In its* A Collection of Stirling Engine Reports from General Motors' Research, 1958 to 1970. Part 3: Stirling Engine Materials and Stresses, 3.1 Stirling Engine Materials, 3.2 Stirling Engine Stresses Apr. 1978 23 p (For availability see N78-26284 17-31)
(GMR-2690-Sect-3.203) Avail: NTIS HC A10/MF A01

The results of a stress analysis for the displacer cylinder of the 10-36 Sirling engine are given. The displacement, strain, and stress in the displacer cylinder are presented for different pressure and thermal loadings. J.M.S.

N78-26294# General Motors Research Labs., Warren, Mich.
EVALUATION OF STRESSES IN TUBES WITH EXTERNAL HEAT FLUX AND INTERNAL PRESSURIZATION c39

Wallace R. Wade *In its* A Collection of Stirling Engine Reports from General Motors' Research, 1958 to 1970. Part 3: Stirling Engine Materials and Stresses, 3.1 Stirling Engine Materials, 3.2 Stirling Engine Stresses Apr. 1978 19 p (For availability see N78-26284 17-31)
(GMR-2690-Sect-3.204) Avail: NTIS HC A10/MF A01

A method is presented for calculating severe stress levels in a heater tube subjected to loads experienced in a Stirling thermal engine. Specific calculations are presented for typical tubes subjected to conditions similar to those of current and possible future interest. The calculations indicate that heater tubes used in engines of current interest are within the safe operating range when the short time yield strength is used as a criterion. For extended periods of operation, creep considerations alter this conclusion. It was concluded that use of similar tubes in higher output engines may not be satisfactory. J.M.S.

N78-26295# General Motors Research Labs., Warren, Mich.
AN INVESTIGATION OF STRESSES CAUSING DEFORMATION IN STIRLING ENGINE DISPLACER CYLINDERS c39

James E. Bennethum and Robbert Diepenhorst *In its* A Collection of Stirling Engine Reports from General Motors' Res., 1958 to 1970. Pt 3: Stirling Engine Materials and Stresses, 3.1 Stirling Engine Materials, 3.2 Stirling Engine Stresses Apr. 1978 29 p (For availability see N78-26284 17-31)
(GMR-2690-Sect-3.205) Avail: NTIS HC A10/MF A01

The calculations discussed were made to explain the observed deformation pattern in Stirling engine displacer cylinders and to determine if this deformation was larger than some safe value. By making calculations based on older designs the relative magnitudes of the stress levels can be used to evaluate the GPU-3 design. The results indicate that there is no immediate danger of failing the cylinder. At this time it appears that the wall is yielding in the low temperature, thin wall sections because of a combination of thermal and pressure stresses. After this

initial deformation, creep in the hotter portions of the wall should be the only reason for concern and ultimately cause the cylinder to fail after a long period of operation. J.M.S.

N78-26296# General Motors Research Labs., Warren, Mich.
A FINITE ELEMENT ANALYSIS OF STRESSES AND DEFORMATIONS IN STIRLING ENGINE DISPLACER CYLINDERS **c39**
Wallace R. Wade *In its* A Collection of Stirling Engine Reports from General Motors' Research, 1958 to 1970. Pt 3: Stirling Engine Materials and Stresses, 3.1 Stirling Engine Materials, 3.2 Stirling Engine Stresses Apr. 1978 45 p (For availability see N78-26284 17-31)
(GMR-2690-Sect-3.206) Avail: NTIS HC A10/MF A01

A finite element analytical method for determining stresses and deformations in a variable thick walled cylinder, subjected to internal pressure and an axially varying wall temperature, is presented. Triaxial stresses and wall deformations in a Stirling engine displacer cylinder may be determined using this method directly. Loads producing stresses beyond the elastic limit of the cylinder wall material are considered. A test program is proposed for increasing the confidence level of the analysis presented. With the reliability of the method verified, further effort should be directed in developing reliable guides and criteria for displacer cylinder design. Author

N78-26297# General Motors Research Labs., Warren, Mich.
STIRLING CYLINDER DEFORMATION MEASUREMENT **c37**
James R. Abel and Raymond M. Cole *In its* A Collection of Stirling Engine Reports from General Motors' Res., 1958 to 1970. Pt 3: Stirling Engine Materials and Stresses, 3.1 Stirling Engine Materials, 3.2 Stirling Engine Stresses Apr. 1978 11 p (For availability see N78-26284 17-31)
(GMR-2690-Sect-3.207) Avail: NTIS HC A10/MF A01

The methods of measurement for cylinder deformation are discussed and typical traces are shown. Also, the data obtained to date are reviewed. Author

N78-26298# General Motors Research Labs., Warren, Mich.
BUCKLING OF STIRLING ENGINE COOLER ASSEMBLIES **c39**
John H. Lienesch *In its* A Collection of Stirling Engine Reports from General Motors' Res., 1958 to 1970. Pt 3: Stirling Engine Materials and Stresses, 3.1 Stirling Engine Materials, 3.2 Stirling Engine Stresses Apr. 1978 6 p (For availability see N78-26284 17-31)
(GMR-2690-Sect-3.208) Avail: NTIS HC A10/MF A01

The buckling strength of the 4L23 Stirling engine cooler assembly is calculated and compared to measured data. Some limits are given for allowable engine pressures. Author

N78-26299# General Motors Research Labs., Warren, Mich.
A COLLECTION OF STIRLING ENGINE REPORTS FROM GENERAL MOTORS' RESEARCH, 1958 TO 1970. PART 4: PISTON ROD SEALS, 4.1 SLIDING SEALS, 4.2 ROLLING DIAPHRAGMS
Apr. 1978 259 p refs
(GMR-2690-Pt-4) Avail: NTIS HC A12/MF A01

Durability data and test results are presented for sliding seals and rolling diaphragm seals, power rod oil pumping ring, displacer rod seal ring, and seal oil control system of the Stirling engine. A quality control program for molding and testing rolling seals is included. For individual titles, see N78-26300 through N78-26311.

N78-26300# General Motors Research Labs., Warren, Mich.
STIRLING THERMAL ENGINE SEAL TEST REPORT 1: LEAK RATES OF COMMERCIAL RECIPROCATING SEALS AGAINST 1500 PSI HELIUM **c37**
F. Earl Heffner and Robert Diepenhorst *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 4: Piston Rod Seals, 4.1 Sliding Seals, 4.2 Rolling Diaphragms Apr. 1978 24 p (For availability see N78-26299 17-31)
(GMR-2690-Sect-4.101) Avail: NTIS HC A12/MF A01

Leak rate data are given from screening tests of commercial seals sealing a reciprocating rod against 1500 psi helium at the speed and stroke of the 1036 Stirling Thermal Engine piston rods. Author

N78-26301# General Motors Research Labs., Warren, Mich.
GPU-3 STIRLING ENGINE MAXIMUM COMPRESSION SPACE TEMPERATURE ENDURANCE TESTS. PART 1: SLIDING SEALS **c37**
Ismail R. Hoyi and Carl A. Schiele *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 4: Piston Rod Seals, 4.1 Sliding Seals, 4.2 Rolling Diaphragms Apr. 1978 45 p refs (For availability see N78-26299 17-31)
(GMR-2690-Sect-4.102) Avail: NTIS HC A12/MF A01

A 3639 hour endurance test program was conducted to define the maximum compression space temperature at which the endurance engine would meet the military requirement of 500 hour life, and to define the engine elements which were most sensitive to high compression space temperature. The critical engine elements were determined to be the nitrile piston rod sliding seals and their polyurethane oil wipers. The maximum allowable compression space temperature was found to be 275 F, reached in the test engine with 160 F cooling water. The test program also provided data showing that MetNet regenerators, Rulon piston rings, the displacer cylinder assembly, and the crankcase had durability lives in excess of the 3639 hour test period, and that the external combustion system elements had lives varying from 1300 to 2900 hours. Author

N78-26302# General Motors Research Labs., Warren, Mich.
STIRLING THERMAL ENGINE SEAL TEST REPORT 2: PROGRESS ON THE ROLLING SEAL, NOVEMBER 1962 TO MAY 1963 **c37**
William H. Ahrens *In its* A Collection of Stirling Eng. Rept. from Gen Motors' Res., 1958 to 1970. Pt. 4: Piston Rod Seals, 4.1 Sliding Seals, 4.2 Rolling Diaphragms Apr. 1978 18 p ref (For availability see N78-26299 17-31)
(GMR-2690-Sect-4.201) Avail: NTIS HC A12/MF A01

The rolling seal, a positive type seal to eliminate hydrogen leakage in a Stirling engine, was tested. Test data obtained thus far are presented as well as a discussion of the rolling seal test machines and of initial efforts to produce and test rolling seals for the research Stirling engines. Also included is a summary of experience to date with the hydrodynamic pump. J.M.S.

N78-26303# General Motors Research Labs., Warren, Mich.
STIRLING THERMAL ENGINE SEAL TEST REPORT 3: INITIAL GMR ROLLING SEAL TESTS, MAY 1963 TO OCTOBER 1963 **c37**
William H. Ahrens *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 4: Piston Rod Seals, 4.1 Sliding Seals, 4.2 Rolling Diaphragms Apr. 1978 6 p (For availability see N78-26299 17-31)
(GMR-2690-Sect-4.202) Avail: NTIS HC A12/MF A01

Physical properties of the various seal materials tested under the rolling seal test program as well as specific data on operating conditions are presented together with a brief summary of test results on the .020 in. wall GMR seals. The erratic nature of the test data indicates the need for an extremely well-controlled compounding, molding, and testing program to produce data upon which further design and development of Stirling engine rolling seals can be based. Author

N78-26304# General Motors Research Labs., Warren, Mich.
STIRLING THERMAL ENGINE SEAL TEST REPORT 4: QUALITY CONTROL PROGRAM FOR MOLDING AND TESTING ROLLING SEALS **c37**
William H. Ahrens *In its* A Collection of Stirling Eng. Rept., from Gen. Motors' Res., 1958 to 1970. Pt. 4: Piston Rod Seals, 4.1 Sliding Seals, 4.2 Rolling Diaphragms Apr. 1978 6 p (For availability see N78-26299 17-31)
(GMR-2690-Sect-4.203) Avail: NTIS HC A12/MF A01

A quality control program in which duplicate batches of seals are made as needed according to step-by-step procedures and then tested under controlled conditions is described. All variables affecting the compounding, handling, and testing processes are controlled so that the test seals are as nearly alike as possible. J.M.S.

N78-26305# General Motors Research Labs., Warren, Mich.
SUMMARY OF RESULTS OF QUALITY CONTROL PROGRAM FOR MOLDING AND TESTING ROLLING SEALS **c38**

William H. Ahrens *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 4: Piston Rod Seals, 4.1 Sliding Seals, 4.2 Rolling Diaphragms Apr. 1978 13 p (For availability see N78-26299 17-31)
(GMR-2690-Sect-4.204) Avail: NTIS HC A12/MF A01

Procedures were established for reducing the effect of uncontrolled variables upon the milling, molding, and testing of seals. All facets of the quality control program were appraised. Results indicate that adherence to these procedures resulted in the manufacture of seals of reasonably uniform quality and that the effect of uncontrolled variables was reduced. J.M.S.

N78-26306# General Motors Research Labs., Warren, Mich.
STIRLING ENGINE ROLLING SEAL Progress Report, Nov. - Dec. 1962 **c37**

Harold E. Trexler *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 4: Piston Rod Seals, 4.1 Sliding Seals, 4.2 Rolling Diaphragms Apr. 1978 8 p (For availability see N78-26299 17-31)
(GMR-2690-Sect-4.205) Avail: NTIS HC A12/MF A01

A project was undertaken to develop improved elastomer materials for use in the rolling seals of the Stirling engine. Nine elastomer compounds (based on four different types of oil resistant elastomers) were formulated and evaluated for physical properties and oil resistance. Of these, four compounds were selected for initial evaluation as rolling seals. The compound formulation and test data are included. J.M.S.

N78-26307# General Motors Research Labs., Warren, Mich.
ELASTOMER ROLLING SEAL FOR STIRLING ENGINE **c37**

Harold E. Trexler *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 4: Piston Rod Seals, 4.1 Sliding Seals, 4.2 Rolling Diaphragms Apr. 1978 11 p (For availability see N78-26299 17-31)
(GMR-2690-Sect-4.206) Avail: NTIS HC A12/MF A01

Conclusion of the rolling seal quality control program is reported. Fabrication of uniform rolling seals for testing, development of seal materials for high temperature operation, screening of test materials by means of a band-type tensile specimen, and modification of Stirling engine test oil to reduce degradation of test seals are among the accomplishments discussed. The hydrogen diffusion rates through three silicone polymers, compound formulations for high temperature rolling seals, Stirling engine test life and tensile strength, elongation, hardness properties, and modulus of rolling seal compounds are listed. J.M.S.

N78-26308# General Motors Research Labs., Warren, Mich.
ELASTOMER ROLLING SEAL FOR STIRLING ENGINE. **c37**

Harold E. Trexler *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 4: Piston Rod Seals, 4.1 Sliding Seals, 4.2 Rolling Diaphragms Apr. 1978 15 p (For availability see N78-26299 17-31)
(GMR-2690-Sect-4.207) Avail: NTIS HC A12/MF A01

High temperature Viton fluoroelastomer rolling seals operated for 568 hours at 165 F before failure. These seals had a delta value of 0.30. An attempt to strengthen the Viton seal by adding 1/4 inch nylon fibers resulted in failure of the seal in less than one hour. High temperature testing resulted in premature degradation of the test oil and may necessitate the addition of larger amounts of oil antioxidant. Viton material aged in oil with higher levels of antioxidant exhibited little or no change. Viton seals tested in the Stirling test apparatus at 200 F failed in less than one hour. Further tests are planned with seals having a lower delta value of 0.25. In the intermediate temperature range (130 F) propylene oxide seals have an operational life of 523 hours at 130 F. They have objectional oil swell but this was reduced to a satisfactory level by Glydex treatment. Electron probe analysis of the propylene oxide seals show a complete fluorination of the seal. Author

N78-26309# General Motors Research Labs., Warren, Mich.
STIRLING ENGINE ROLLING SEAL CONTROL SYSTEMS **c37**

Richard R. Toepel *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 4: Piston Rod Seals, 4.1 Sliding Seals, 4.2 Rolling Diaphragms Apr. 1978 11 p ref (For availability see N78-26299 17-31)
(GMR-2690-Sect-4.208) Avail: NTIS HC A12/MF A01

The required functions of the Stirling engine rolling seal control system are presented. Two control systems are described in detail including the integration with the complete engine systems. Results of engine evaluation of the control systems are presented. Author

N78-26310# General Motors Research Labs., Warren, Mich.
SOME FACTORS IN ROLLING DIAPHRAGM SEAL LIFE **c38**

Dennis C. Kuzma *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 4: Piston Rod Seals, 4.1 Sliding Seals, 4.2 Rolling Diaphragms Apr. 1978 10 p refs (For availability see N78-26299 17-31)
(GMR-2690-Sect-4.209) Avail: NTIS HC A12/MF A01

Several factors which could contribute to the life of rolling diaphragm seals were investigated. Seal inertia effects, hydrodynamic pressure effects, and hydrodynamic inertia effects were found to be small. The peeling of the seal from the wall was found to be an important factor in seal life. Author

N78-26311# General Motors Research Labs., Warren, Mich.
GPU-3 STIRLING ENGINE MAXIMUM COMPRESSION SPACE TEMPERATURE ENDURANCE TESTS. PART 2: ROLLING DIAPHRAGM SEALS **c38**

Ismail R. Hoyi *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 4: Piston Rod Seals, 4.1 Sliding Seals, 4.2 Rolling Diaphragm Apr. 1978 87 p refs (For availability see N78-26299 17-31)
(GMR-2690-Sect-4.210) Avail: NTIS HC A12/MF A01

Some 2654 hours of tests were conducted in the rolling seal program, and data of interest were generated. It appears that the initial target life of 500 hours between overhauls can be obtained in a rolling seal engine at compression space temperatures up to 238 F. This temperature was reached in the test engine at 125 F cooling water inlet temperature. The engine components most needing further development to allow higher temperature operation appear to be the rolling seal itself, the power rod oil pumping ring, the displacer rod seal ring, and the seal oil control system. The test program also provided significant extensions of durability data on major Stirling engine parts, which are discussed. Typical lives listed are: crankcase assembly - 4746 hours, cylinder-heater assembly - 4064 hours, burner assembly - 2189 hours, preheater - 4410 hours, MetNet regenerators - 4101 hours, piston rings - 4374 hours, fuel nozzle - 4746 hours. Author

N78-26312# General Motors Research Labs., Warren, Mich.
A COLLECTION OF STIRLING ENGINE REPORTS FROM GENERAL MOTORS' RESEARCH, 1958 TO 1970. PART 5: PISTON SEALS
Apr. 1978 104 p
(GMR-2690-Pt-5) Avail: NTIS HC A06/MF A01

Reports on the Stirling Cycle Engine covering power piston seal tests and power piston pumping loss are presented. For individual titles, see N78-26313 through N78-26317.

N78-26313# General Motors Research Labs., Warren, Mich.
STIRLING ENGINE POWER PISTON SEAL TEST **c38**

Raymond M. Cole *In its* A Collection of Stirling Eng. Repts. from General Motors' Res., 1958 to 1970. Part 5: Piston Seals Apr. 1978 13 p (For availability see N78-26312 17-31)
(GMR-2690-Sect-5.001) Avail: NTIS HC A06/MF A01

A cursory examination was made of the relative effectiveness of several power piston seals for the 10 HP Stirling Engine. The seals tested are described along with an analysis of the results. D.L.G.

N78-26314# General Motors Research Labs., Warren, Mich.
PERFORMANCE TESTING OF POWER PISTON SEALS FOR THE STIRLING THERMAL ENGINE **c37**

Robert J. Bayer *In its* A Collection of Stirling Eng. Repts. from General Motors' Res., 1958 to 1970. Part 5: Piston Seals

Apr. 1978 26 p (For availability see N78-26312 17-31)
(GMR-2690-Sect-5.002) Avail: NTIS HC A06/MF A01

Nine designs of power piston seals employing self-lubricating materials were tested in the Model 1036R Stirling Thermal Engine. Four of these designs exhibited acceptable performance but require endurance testing to establish their life. Author

N78-26315# General Motors Research Labs., Warren, Mich.
STIRLING THERMAL ENGINE POWER PISTON PUMPING LOSS - EXPERIMENTAL AND THEORETICAL RESULTS **c37**

David K. Dorer *In its* A Collection of Stirling Eng. Repts. from General Motors' Res., 1958 to 1970. Part 5: Piston Seals Apr. 1978 34 p (For availability see N78-26312 17-31)
(GMR-2690-Sect-5.003) Avail: NTIS HC A06/MF A01

The pumping power loss associated with Stirling engine power piston leakage was calculated for various known amounts of piston leakage. These results are compared with experimentally observed data. A means of experimentally determining whether the seal leakage flow is laminar or turbulent and the leakage loss coefficient of power piston seals while in engines operating under power is also presented with the equations necessary to determine the pumping power loss. The analysis includes the effects of unequal pumping where the mean buffer and working gas pressures are unequal. Author

N78-26316# General Motors Research Labs., Warren, Mich.
PUMPING POWER LOSS EQUATIONS FOR THREE TYPICAL STIRLING THERMAL ENGINE CASES **c37**

David K. Dorer *In its* A Collection of Stirling Eng. Repts. from General Motors' Res., 1958 to 1970. Part 5: Piston Seals Apr. 1978 11 p (For availability see N78-26312 17-31)
(GMR-2690-Sect-5.004) Avail: NTIS HC A06/MF A01

Pumping power loss equations for three typical Stirling thermal engine cases are presented with a discussion of their application and limitations. Author

N78-26317# General Motors Research Labs., Warren, Mich.
POWER LOSS ASSOCIATED WITH STIRLING THERMAL ENGINE DISPLACER PISTON VENTING **c37**

David K. Dorer *In its* A Collection of Stirling Eng. Repts. from General Motors' Res., 1958 to 1970. Part 5: Piston Seals Apr. 1978 9 p (For availability see N78-26312 17-31)
(GMR-2690-Sect-5.005) Avail: NTIS HC A06/MF A01

The equation necessary to determine the power loss caused by displacer piston venting in the Stirling thermal engine is derived. The resulting equation was experimentally verified with available 1036R Stirling engine test data. Also, the theoretical effects of displacer piston venting on power output for the 8015 Stirling engine is presented. Author

N78-26318# General Motors Research Labs., Warren, Mich.
A COLLECTION OF STIRLING ENGINE REPORTS FROM GENERAL MOTORS' RESEARCH, 1958 TO 1970. PART 6: REGENERATORS

Apr. 1978 130 p refs
(GMR-2690-Pt-6) Avail: NTIS HC A06/MF A01

The Stirling Thermal Engine regenerator cost reduction program is outlined. For individual titles, see N78-26319 through N78-26325.

N78-26319# General Motors Research Labs., Warren, Mich.
STIRLING THERMAL ENGINE REGENERATOR COST REDUCTION PROGRAM OUTLINE **c37**

John C. Steiner *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 6: Regenerators Apr. 1978 5 p (For availability see N78-26318 17-31)
(GMR-2690-Sect-6.001) Avail: NTIS HC A06/MF A01

The procedure to be followed in evaluating potential regenerator matrix materials is outlined. The objective is to determine the cost of alternative materials and the effect that lower cost materials will have upon engine performance. L.S.

N78-26320# General Motors Research Labs., Warren, Mich.
STIRLING THERMAL ENGINE REGENERATOR COST REDUCTION PROGRAM REPORT 1: WIRE CLOTH MATRIX MATERIALS **c24**

John C. Steiner *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 6: Regenerators Apr. 1978 10 p (For availability see N78-26318 17-31)
(GMR-2690-Sect-6.002) Avail: NTIS HC A06/MF A01

Costs of wire cloth regenerator matrix materials for volume production are presented along with the predicted Stirlig Engine performance with the wire cloth materials. The costs of the ideal material were estimated to be 15 to 20 percent of the allowable cost of the entire engine and the Divisions desired an order of magnitude reduction of this cost to 0.90 dollars per engine horsepower. Some cost reduction is possible with wire cloth of other than ideal configuration and this was studied. Results of this wire cloth analysis are described. L.S.

N78-26321# General Motors Research Labs., Warren, Mich.
STIRLING ENGINE REGENERATOR PERFORMANCE ANALYSIS **c37**

James R. Mondt *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 6: Regenerators Apr. 1978 25 p refs (For availability see N78-26318 17-31)
(GMR-2690-Sect-6.003) Avail: NTIS HC A06/MF A01

The packed wire regenerator for the Stirling engine was developed for best engine performance. The high cost of this regenerator prompted a study of alternate regenerator core materials which could provide equivalent engine performance but at a significant cost reduction relative to the packed screen. An investigation was undertaken of regenerator core materials that have been considered for the vehicular gas turbine regenerator; GMR surface, CERCOR ceramic, and sphere bed. A steady-state model simulation was made of the thermodynamic behavior of the packed screen regenerator for a 10 horsepower Stirling engine. This was used as a baseline for comparison of alternate core material candidates. The results of the study indicate a regenerator core, which will provide equivalent engine performance, can be fabricated from the GMR surface, CERCOR ceramic or ceramic sphere bed at a cost of approximately 50 cents per horsepower. Cost estimates were based on medium volume production rates, hence, there is the potential of further cost reduction. L.S.

N78-26322# General Motors Research Labs., Warren, Mich.
STIRLING THERMAL ENGINE REGENERATOR COST REDUCTION PROGRAM. REPORT 2: JUNE 1965 STATUS **c37**

John C. Steiner *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 6: Regenerators Apr. 1978 23 p refs (For availability see N78-26318 17-31)
(GMR-2690-Sect-6.004) Avail: NTIS HC A06/MF A01

Early cost estimates of Stirling Engines indicated that the regenerators were the part most in need of cost reduction if the engine was to compete successfully on the commercial market. A goal to reduce the regenerator costs by an order of magnitude to 0.90 dollars per engine horsepower was set for the Regenerator Cost Reduction Program. Sample test regenerators were made from materials which would cost as little as 0.15 dollars per engine horsepower. The Cost Reduction Program consists of a thorough cost analysis and experimental evaluation of the fluid friction and heat transfer characteristics of the candidate materials. Regenerator geometry optimization, engine optimization and manufacturing technique are studied to accommodate the characteristics of the different materials. If 1.32 dollars per engine horsepower wire cloth is used in a properly designed engine in place of the present optimum 11.70 dollars per engine horsepower wire cloth, 98 per cent of the present power and 95.1 per cent of the present maximum efficiency can be attained. L.S.

N78-26323# General Motors Research Labs., Warren, Mich.
STIRLING THERMAL ENGINE REGENERATOR COST REDUCTION PROGRAM. REPORT 3: MANUFACTURING THE ELECTRO-MOTIVE DIVISION 4S/8V12C STIRLING ENGINE REGENERATORS **c37**

John C. Steiner and Robert Diepenhorst *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 6: Regenerators Apr. 1978 17 p refs (For availability see N78-26318 17-31)
(GMR-2690-Sect-6.005) Avail: NTIS HC A06/MF A01

The manufacturing procedure includes special wire cloth specifications which must be closely followed for ease in production. Wire cloth configuration measuring methods are described for use in the production of wire cloth regenerators

and the results of tests performed on the EMD regenerators are reported. The wire cloth punch mechanism which is described could be automated for large volume production. L.S.

N78-26324# General Motors Research Labs., Warren, Mich.
STIRLING THERMAL ENGINE REGENERATOR COST REDUCTION PROGRAM. REPORT 4: MET NET FLUID FRICTION HEAT TRANSFER TEST RESULTS, ENGINE TEST FOR FOUR REGENERATION MATERIALS **c37**
John C. Steiner *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 6: Regenerators Apr. 1978 45 p refs (For availability see N78-26318 17-31)
(GMR-2690-Sect-6.006) Avail: NTIS HC A06/MF A01

The major effort was concentrated on the testing of the GMR MetNet material developed by the Metallurgical Engineering Department which has a projected cost of 0.15 dollars per engine horsepower. Initial tests of the fluid friction and heat transfer characteristics of the material were completed. Engine tests were performed utilizing the low cost 150 mesh wire cloth and the lowest cost MetNet materials. The structural integrity of MetNet was proven in 100 hours of engine operation with 0.15-0.25 MetNet. The GPU size Stirling engine at full load utilizing 150 mesh wire cloth regenerators produced 100 per cent of the power and 89 per cent of the efficiency of the same engine utilizing the standard 200 mesh wire cloth. The engine using 0.05-0.20 MetNet produced 91 per cent of the power and 89 per cent of the engine efficiency of the engine utilizing standard regenerators. L.S.

N78-26325# General Motors Research Labs., Warren, Mich.
A PROCEDURE FOR FLAME SPRAYING METNET REGENERATORS **c37**
John H. Lienesch *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 6: Regenerators Apr. 1978 11 p ref (For availability see N78-26318 17-31)
(GMR-2690-Sect-6.007) Avail: NTIS HC A06/MF A01

A procedure was worked out for the fabrication of the regenerators for the 4L23 Stirling engine. These regenerators are made from thin MetNet disks which are stacked together, flame sprayed, and then machined to size. Flow tests on the finished regenerators indicate that their flow resistance is very close to that predicted from other experimental data on MetNet. L.S.

N78-26326# General Motors Research Labs., Warren, Mich.
A COLLECTION OF STIRLING ENGINE REPORTS FROM GENERAL MOTORS' RESEARCH, 1958 TO 1970. PART 7: THERMAL ENERGY STORAGE AND PUBLICATION LIST, 7.1 THERMAL ENERGY STORAGE, 7.2 LIST OF GENERAL MOTORS STIRLING ENGINE PUBLICATIONS
Apr. 1978 243 p refs
(GMR-2690-Pt-7) Avail: NTIS HC A11/MF A01

Various aspects of thermal energy storage were studied for use in the Stirling cycle engine. Lithium hydroxide heat storage system; heat transfer and pressure drop across ground power unit heater; brazed test assembly exposed to molten LiOH; nickel tanks; and energy transfer rates from solidifying lithium fluoride to a plain tube heater were evaluated. The results from these tests are presented. For individual titles, see N78-26327 through N78-26337.

N78-26327# General Motors Research Labs., Warren, Mich.
A TEST INSTALLATION OF LITHIUM HYDROXIDE HEAT STORAGE SYSTEM **c44**
Michael Tsou *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 7: Thermal Energy Storage and Publ. List, 7.1 Thermal Energy Storage, 7.2 List of Gen. Motors Stirling Eng. Publ. Apr. 1978 14 p (For availability see N78-26326 17-31)
(GMR-2690-Sect-7.101) Avail: NTIS HC A11/MF A01

A lithium hydroxide heat storage test installation is described. The object of this installation is to gain working experience with heat storage systems of this type, involving the handling of the storage material, loading of the storage tank, corrosion control, as well as to obtain information on its heat up, cooldown characteristics. J.A.M.

N78-26328# General Motors Research Labs., Warren, Mich.
DEVELOPMENT OF A LITHIUM HYDROXIDE HEAT STORAGE SYSTEM Progress Report **c44**
Michael Tsou *In* Its A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 7: Thermal Energy Storage and Publ. List, 7.1 Thermal Energy storage, 7.2 List of Gen. Motors Stirling Eng. Publ. Apr. 1978 16 p (For availability see N78-26326 17-31)
(GMR-2690-Sect-7.102) Avail: NTIS HC A11/MF A01

Techniques for purging and loading the lithium hydroxide heat storage system are described. Results of tests on insulation losses and heat transfer rates are also presented. J.A.M.

N78-26329# General Motors Research Labs., Warren, Mich.
THERMAL ENERGY STORAGE FOR ROAD VEHICLE PROPULSION **c44**
Worth H. Percival *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 7: Thermal Energy Storage and Publ. Lists, 7.1 Thermal Energy Storage, 7.2 List of Gen. Motors Stirling Eng. Publ. Apr. 1978 23 p (For availability see N78-26326 17-31)
(GMR-2690-Sect-7.103) Avail: NTIS HC A11/MF A01

Small systems are shown to be at a considerable disadvantage compared to large systems. The problem of heat loss and insulation is described, and methods of transferring heat from the storage unit to the engine are explained. Various properties and heat capacity of 10 solid heat storage substances are compared to lithium fluoride. Three compounds are then compared for a specific application to a small vehicle, and boron carbide is recommended. A small two passenger vehicle is briefly described, along with some theoretical performance. A particular Stirling engine and its ancillaries are explained, along with several transmission types. The weight of the power system is estimated and compared to an electric battery system. Author

N78-26330# General Motors Research Labs., Warren, Mich.
THERMAL ENERGY STORAGE STIRLING ENGINE POWER PLANTS 1: CALCULATED HEAT TRANSFER AND PRESSURE DROP ACROSS GROUND POWER UNIT HEATER ASSEMBLIES **c34**
John C. Steiner *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 7: Thermal Energy Storage, 7.1 Thermal Energy Storage, 7.2 List of Gen. Motors Stirling Eng. Publ. Apr. 1978 24 p refs (For availability see N78-26326 17-31)
(GMR-2690-Sect-7.104) Avail: NTIS HC A11/MF A01

A power plant basically consisting of a thermal energy storage tank, an existing ground power unit-size Stirling engine and a gas circulating system for transporting energy from the thermal energy storage tank to the engine is considered. The external heat transfer to the engine heater and attendant circulating gas pumping losses are analytically studied. Results show that the pumping losses would be appreciable for the existing heater design, and several new plain tube configurations are proposed to reduce these losses. The most significant reduction in pumping losses would be realized with a heater design of the same number of tubes and spacing as the existing design, but with a 133 percent increase in heater height. The new heater configurations show decreases in the heater outlet gas temperatures at which the circulation blower must operate. Author

N78-26331# General Motors Research Labs., Warren, Mich.
EXAMINATION OF CALVAIR STIRLING ENGINE BRAZED TEST ASSEMBLY AFTER EXPOSURE TO MOLTEN LiOH **c37**
John N. Johnson *In its* A Collection of Stirling Eng. Rept. from Gen. Motors; Res., 1958 to 1970. Pt. 7: Thermal energy Storage and Publ. List, 7.1 Thermal Energy Storage, 7.2 List of Gen. Motors Stirling Eng. Publ. Apr. 1978 12 p (For availability see N78-26326 17-31)
(GMR-2690-Sect-7.105) Avail: NTIS HC A11/MF A01

A metallurgical investigation of a test brazed assembly showed the Inconel 600 alloy to be selectively oxidized by the LiOH to form a thick (0.015 in.) layer of Cr and Fe oxides mixed with metallic nickel. The Au-Mi braze alloy showed some attack in the fillet area with Fe and Cr (probably oxides) being deposited within the braze alloy. Both forms of attack would be expected to continue with further exposure. The contaminated

nature of the bath must be regarded as a possible cause for attack. Author

N78-26332# General Motors Research Labs., Warren, Mich.
ANALYSIS OF THE FAILURE OF THE NICKEL TANK USED FOR LiOH THERMAL ENERGY STORAGE FOR THE CALVAIR AUTOMOBILE **c38**
John C. Bierlein *In its* A collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 7: Thermal Energy Storage and Publ. List, 7.1 Thermal Energy Storage, 7.2 List of Gen. Motors Stirling Eng. Publ. Apr. 1978 34 p ref (For availability see N78-26326 17-31)
(GMR-2690-Sect-7.106) Avail: NTIS HC A11/MF A01

This nickel thermal energy storage tank for use with lithium hydroxide was designed for use in the Calvair automobile. The failure of this tank was caused by several factors. The relative importance of each of these factors is discussed. Author

N78-26333# General Motors Research Labs., Warren, Mich.
ENERGY STORAGE SYSTEMS COMPLEMENT THE STIRLING ENGINE
In its A Collection of Stirling Eng. Rept. from Gen. Motors Res., 1958 to 1970. Pt. 7: Thermal Energy Storage and Publ. List, 7.1 Thermal Energy Storage, 7.2 List of Gen. Motors Stirling Eng. Publ. Apr. 1978 3 p (For availability see N78-26326 17-31)
(GMR-2690-Sect-7.107) Avail: NTIS HC A11/MF A01

The heat energy converter of the Stirling engine is described, along with the Calvair automobile (converted '64 Corvair with a Stirling engine). The energy storage capacity of various sources and the output available during energy conversion are shown in tabular form, using watt-hours per pound and watt-hours per cubic inch as measurement. J.A.M.

N78-26334# General Motors Research Labs., Warren, Mich.
THERMAL ENERGY STORAGE--STIRLING ENGINE POWER PLANTS 2. CALCULATED ENERGY TRANSFER RATES FROM SOLIDIFYING LITHIUM FLUORIDE TO A PLAIN-TUBE HEATER **c44**
A. Cocanower *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res, 1958 to 1970. Pt. 7: Thermal Energy Storage and Publ. List; 7.1 Thermal Energy Storage, 7.2 List of Gen. Motors Stirling Eng. Publ. Apr. 1978 49 p refs (For availability see N78-26326 17-31)
(GMR-2690-Sect-7.108) Avail: NTIS HC A11/MF A01

An idealized model of the system was set up and the calculated results indicate that energy could be transferred at a rate sufficient to produce an engine output of 10 horsepower for 10 hours or 20 horsepower for 7 hours. The accuracy of the results is limited to the validity of the idealized model as well as to the certainty of the data, such as the thermal conductivity of lithium fluoride and the heat transfer film coefficients. Author

N78-26335# General Motors Research Labs., Warren, Mich.
METALLURGICAL STUDIES OF HIGH TEMPERATURE ALLOY CAPSULES AFTER LONG TIME CYCLIC CORROSION TESTS AS CONTAINERS FOR LITHIUM FLUORIDE **c26**
Erwin R. Cprek *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 7: Thermal Energy Storage and Publ. List, 7.1 Thermal Energy Storage, 7.2 List of Gen. Motors Stirling Eng. Publ. Apr. 1978 23 p (For availability see N78-26326 17-31)
(GMP-2690-Sect-7.109) Avail: NTIS HC A11/MF A01

Corrosion resistance and effect of the purity of the lithium fluoride on the rate of attack were of primary interest in evaluating the materials. Results of the examination showed no significant corrosion attack on any of the five alloys represented. The use of ultrahigh purity lithium fluoride did not appear to be justified as a means of controlling corrosion attack. Author

N78-26336# General Motors Research Labs., Warren, Mich.
PERFORMANCE EVALUATION OF A STIRLING CYCLE HEAT PUMP **c34**
John H. Lienesch *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 7: Thermal Energy Storage and Publ. List, 7.1 Thermal Energy Storage, 7.2 List of Gen. Motors Stirling Eng. Publ. Apr. 1978 17 p (For availability see N78-26326 17-31)
(GMR-2690-Sect-7.110) Avail: NTIS HC A11/MF A01

Interest in Stirling-powered underwater vehicles has focussed on thermal energy storage systems. Using the engine itself as a heat pump by motoring it in the reverse direction was proposed. Data taken on a ten-horsepower dynamometer engine indicate that such a system is feasible. The effect of speed, temperature, and pressure on heat pump performance is shown in the form of performance maps at various steady state operating conditions. J.A.M.

N78-26337# General Motors Research Labs., Warren, Mich.
THERMAL ENERGY STORAGE-STIRLING ENGINE POWER-PLANTS FOR ROAD VEHICLES **c44**
James N. Mattavi *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 7: Thermal Energy Storage and Publ. List; 7.1 Thermal Energy Storage, 7.2 List of Gen. Motors Stirling Eng. Publ. Apr. 1978 23 p refs (For availability see N78-26326 17-31)
(GMR-2690-Sect-7.111) Avail: NTIS HC A11/MF A01

The performance of thermal energy storage-Stirling engine powerplants is predicted for six types of road vehicles; these include a family car, commuter car, utility car, delivery van, city taxi, and city bus. Vehicle requirements were taken from study programs on low pollution potential, propulsion systems for urban vehicles. Data on TES-Stirling engine powerplants for the same study guidelines are provided. J.A.M.

N78-26338# Coastal Engineering Research Center, Fort Belvoir, Va.
ACCELERATION AND IMPACT OF STRUCTURES MOVED BY TSUNAMIS OR FLASH FLOODS
Frederick E. Campfield Feb. 1978 16 p refs Presented at the US Army Engr. Div., South Pacific's Water Level Prediction Short Course, San Francisco, 30 Mar. - 1 Apr. 1976 and at the Tsunami Symp., Ensenada, Mexico, 23-26 Mar. 1977
(AD-A053173; CERC-CETA-78-1) Avail: NTIS HC A02/MF A01 CSCL 13/2

Techniques are given for determining the velocity of a structure moved by a tsunami or flash flood and impact forces with another structure. Solutions can be obtained for velocity and impact force as a function of the initial distance between the structures and the velocity of the surging water. Author (GRA)

N78-26339# National Bureau of Standards, Washington, D. C.
FIRE ENDURANCE TESTS OF RESIDENTIAL WALLS CONTAINING BRANCH CIRCUIT WIRING, PRELIMINARY FINDINGS Final Report
Lionel A. Issen Feb. 1978 65 p refs Sponsored by HUD, Washington, D. C.
(PB-277536/9; NBSIR-78-1415) Avail: NTIS HC A04/MF A01 CSCL 13M

The effects of branch circuit electric wiring and wiring devices on the fire resistance of a gypsum board and wood stud one-hour fire-rated wall was studied. The tests simulated potential fire spread between horizontally adjacent occupancies and vertically adjacent occupancies. Each test wall assembly included both nonmetallic sheathed cable and armoured cable, with and without 3-1/2 inch thick glass fiber insulation. The tests showed that the presence and penetrations of electric branch circuit cables and wiring devices lowered the fire resistance of a one-hour rated gypsum board and wood-stud wall by 13 minutes when based on flame penetration of the unexposed surface wallboard, and by 23 minutes when based on flame penetration at the wiring devices. GRA

N78-26340# Sandia Labs., Albuquerque, N. Mex. Reactor Safety Studies Div.
RESPONSE OF CONCRETE EXPOSED TO A HIGH HEAT FLUX ON ONE SURFACE
J. F. Muir Nov. 1977 232 p refs
(Contract EY-76-C-04-0789)
(SAND-77-1467) Avail: NTIS HC A10/MF A01

The response of concrete was studied during the interaction of molten reactor core materials with the containment substructure following a hypothetical fuel melt accident. The dominant mechanism for erosion of both limestone and basaltic concrete appeared to be melting of the cementitious material in the matrix. The erosion proceeded in a quiescent manner with negligible

spallation. The erosion rate increased with heat flux, becoming as large as approximately 70 cm/hr for a net surface heat flux of roughly 190 W/sq cm. The surface temperature was the single most significant parameter affecting net surface heat flux. The greatest fraction of the net energy transmitted to the concrete goes into sensible heat. ERA

N78-26341# National Bureau of Standards, Washington, D. C. Center for Building Technology.
RELIABILITY BASIS OF LOAD AND RESISTANCE FACTORS FOR REINFORCED CONCRETE DESIGN Final Report
Bruce Ellingwood Feb. 1978 102 p refs
(PB-277670/6; NBS-BSS-110) Avail: NTIS HC A06/MF A01 CSCL 13M

Reliability methods are employed to facilitate the selection of criteria for reinforced concrete design. These methods, which are based on probability theory, provide a logical basis for determining the manner in which uncertainties in resistance and loads affect design safety and how their effects should be controlled in building standards. Following a comprehensive analysis of uncertainty measures, safety indices associated with existing reinforced concrete design were evaluated. Design criteria commensurate with levels of uncertainty and required reliability are then presented. GRA

N78-26342# Transport and Road Research Lab., Crowthorne (England).
THE EFFICIENCY OF OPERATION OF EARTHMOVING PLANT ON ROAD CONSTRUCTION SITES
A. W. Parsons 1977 22 p refs
(PB-277724/1; TRRL-Supplementary-351) Avail: NTIS HC A02/MF A01 CSCL 13B

Descriptions of the techniques used in the site observations and methods of analysis of the data are included. The results show that losses in efficiency totalled 37 percent of the overall machine time observed. This figure does not include the slowing down effects due to adverse soil conditions. About half of the losses (19 percent) occurred while the machines were empty, i.e., returning from the fill to the excavation area, while only 5 percent was lost during the loaded part of the earthmoving cycle. The remainder of the losses (13 percent) were associated with machines that were absent from the earthmoving operations, usually in the plant yard undergoing repair. GRA

N78-26343# Illinois State Dept. of Transportation, Springfield. Bureau of Materials and Physical Research.
PCC PAVEMENT TEXTURING IN ILLINOIS Interim Report, Aug. 1976 - Feb. 1977
John N. Davidson May 1977 44 p refs
(PB-277741/5; FHWA/IL/PR-77/74; Physical Research-74) Avail: NTIS HC A03/MF A01 CSCL 13B

Textures were formed in the plastic surface of a CRC pavement during construction. They were formed using transverse tines, transverse broom, artificial turf, transverse roller, artificial turf-transver tine combination, longitudinal broom, and longitudinal tines. Construction observations indicated that the use of one machine for both texturing and applying curing membrane was unsatisfactory since the timing of the two operations was incompatible. Roadometer tests gave roughness index values in inches/mile, ranging from 72 for the longitudinal broom to 91 for the turf-tine combination. GRA

N78-26344# Minnesota Univ., Minneapolis. Dept. of Civil and Mining Engineering.
DESIGN CHARACTERISTICS OF NEAR SURFACE ROCK FORMATIONS Progress Report
Donald H. Yardley and Charles R. Nelson Jul. 1977 40 p refs
(Grant NSF APR-72-03575-A05)
(PB-277708/4; NSF/RA-770198) Avail: NTIS HC A03/MF A01 CSCL 13B

The main campus of the University of Minnesota is underlain by a flat-lying competent limestone and it, in turn, by an easily excavated sandstone. For the project, an excavation was planned. Phases 1 and 2 of the project included: installing instrumentation from the surface and from underground pilot drifts along the test room centerlines; and the development of a spray-grouting technique for in-place hardening of friable sandstone walls in rooms or tunnels. Phase 3 involves the actual widening of the room in stages and monitoring the response of the limestone formation to the different spans. Other aspects of the project include: preparation of a design approach for cavern roofs in jointed and laminated rocks; and encouraging the utilization of research results in general practice and demonstrating the potential of underground construction in an urban environment. GRA

N78-26345# Transportation Research Board, Washington, D. C.
CONSOLIDATION OF CONCRETE FOR PAVEMENTS, BRIDGE DECKS, AND OVERLAYS Final Report
Nov. 1977 69 p refs
(Contract HR20)
(PB-277404/0; TRB/NCHRP/SYN-44; ISBN-0-309-02546-X) Avail: NTIS HC A04/MF A01 CSCL 13B

Current procedures for consolidation of concrete for pavements, bridge decks, and overlays are evaluated and research needs are identified. GRA

32 COMMUNICATIONS

Includes land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Spacecraft Communications, Command and Tracking*.

N78-26346 Colorado Univ., Boulder.
ELECTROMAGNETIC SCATTERING FROM PERIODIC ROUGH SURFACES Ph.D. Thesis
Rayner Karl Rosich 1977 403 p
Avail: Univ. Microfilms Order No. 78-08930

A simple scalar model involving propagation transverse to a cylindrical periodic (two dimensional) surface is developed. By using a perturbation analysis, a general expression is obtained for the amplitude of the scattered waves which is valid for all spectral and all perturbation orders. In addition, the general expression permits one to discern some important properties of the amplitudes for a purely sinusoidal surface. Among other things, it shows that all odd perturbation orders are zero for the specular mode. An improved vector model is outlined which incorporates a proposed alternative to the Rayleigh hypothesis which is used to obtain the modal expansion of the solution used in the simple model. All of the models developed are illustrated and compared by numeric examples. This includes consideration of the convergence of the numerical point-matching solution and analytical perturbation solution, as well as an error analysis of these results. Dissert. Abstr.

N78-26347 New Mexico State Univ., Las Cruces.
ELECTROMAGNETIC PHENOMENA RELATED TO MOVING AND TIME-VARYING SYSTEMS Ph.D. Thesis
James Roy Newhouse 1977 132 p
Avail: Univ. Microfilms Order No. 78-07999

Formation of electromagnetic theory is applied to a study of moving media. The media are considered to be homogeneous and isotropic with respect to frames of reference attached to the media. Using constitutive relations, formulae are developed which extend the concepts of permittivity, permeability, and intrinsic impedance to moving media. The structure of plane electromagnetic waves that moving media can support is determined. The behavior of signal waves in the form of weak electromagnetic plane waves and the beams obliquely scattered from the interface are studied. A general solution of the wave equation is found for two situations involving moving boundaries. The legitimacy of the concept of a phenomenological photon for material media is considered and shows that under certain conditions the deBroglie concept of the photon can be extended to material media. Radiation pressure on the interface between media and a slab region are calculated using the photon concept and classical electromagnetic theory. Dissert. Abstr.

N78-26348 British Broadcasting Corp., Kingswood (England). Engineering Div.
AN EXPERIMENTAL SIMPLE DIGITAL FIELD-STORE

SYNCHRONISER FOR SYSTEM 1 TELEVISION
R. Walker May 1978 19 p refs
(BBC-RD-1978/16) Avail: BBC, Kingswood Warren, Tadworth, Surrey, England

Synchronization of television picture sources is a necessary prerequisite for modern program production methods. Two methods are available which can synchronize sources, at least to within an acceptable error range. The first, relies on a comparison of the timings of the remote source and the reference to generate an error signal which can be used to alter the timing of either the source or the reference in such a way as to reduce the error to an acceptable value. The second method uses a variable delay, usually in the source signal chain, to alter the relative timing between sources and reference. This variable delay and its associated (automatic) controls are usually referred to by the collective title of a field (or picture or frame)-store synchronizer. Potential applications in the BBC for a new, relatively inexpensive field-store synchronizer are considered, and the basic requirements of such a device are identified. The design philosophy and circuit details and the problems which would be encountered in the design of a production sychronizer were investigated. The results show that the basic ideas and most of the final circuit arrangements were adequate. G.Y.

N78-26349*# Texas Univ., Austin. Electrical Engineering Research Lab.
CTS ATTENUATION AND CROSS-POLARIZATION MEASUREMENTS AT 11.7 GHz Final Report, 12 Jun. - 30 Aug. 1976
W. J. Vogel and A. W. Straiton Apr. 1977 34 p refs
(Contract NAS5-22576)
(NASA-CR-156771) Avail: NTIS HC A03/MF A01 CSCL 20N

The results of data obtained 80 days preceding the solar eclipse shutdown of the CTS 11.7 GHz righthand circularly polarized beacon transmitter are presented. Attenuation and cross polarization isolation were measured. It was determined that depolarization presents a serious limitation to satellite system reliability when frequency reuse by polarization diversity is employed. A 27 db isolation margin would reduce reliability below 99.95%. For the same percentage the required fade margin was below 3 db. Author

N78-26350*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SCATTERING OF TERRESTRIAL KILOMETRIC RADIATION AT VERY HIGH ALTITUDES
J. K. Alexander, M. L. Kaiser, and P. Rodriguez Jun. 1978 38 p refs
(NASA-TM-79572) Avail: NTIS HC A03/MF A01 CSCL 20N

On a number of occasions during the 3.8 yr. operating lifetime of RAE-2, strong terrestrial kilometric radiation was observed when the spacecraft was over the far side of the moon and when the low altitude terrestrial magnetosphere was completely obscured from view. If these deep lunar occultation events are used to infer radio source locations, then it is found that the apparent source must sometimes be situated at geocentric distances of 10 to 40 sub E or more. From an analysis of these events, it is shown that they are probably due to propagation effects rather than the actual generation of the emission at such large distances. The kilometric radiation can be generated near the earth at auroral latitudes and subsequently strongly scattered in the magnetosheath and nearby solar wind to produce the large apparent distances. The most likely scatterers are density inhomogeneities in the magnetosheath plasma and ion plasma waves in the magnetosheath and the upstream solar wind. L.S.

N78-26351# Kansas Univ. Center for Research, Inc., Lawrence. Remote Sensing Lab.
RADAR IMAGE SIMULATION: VALIDATION OF THE POINT SCATTERING METHOD, VOLUME 2
J. C. Holtzman, V. H. Kaupp, J. L. Abbott, V. S. Frost, and E. E. Komp Sep. 1977 363 p refs
(Contract DAAG53-76-C-0154)
(AD-A053240; RSL-TR-319-Vol-2; ETL-0118-Vol-2) Avail: NTIS HC A16/MF A01 CSCL 17/9

The technical details of all aspects of the radar image simulation are reported. In particular, the activities associated with the Point Scattering Method are discussed. They include: (1) construction of a ground truth data base, i.e., the terrain model which incorporates elevation and dielectric behavior; (2) digitization of the terrain information to build a digital matrix; (3) formation of a backscatter data catalogue; (4) radar device modeling; and (5) problems and solutions inherent in image handling and analysis. Author (GRA)

N78-26352# Kansas Univ. Center for Research, Inc., Lawrence. Remote Sensing Lab.
RADAR IMAGE SIMULATION: VALIDATION OF THE POINT SCATTERING METHOD, VOLUME 1
J. C. Holtzman, V. H. Kaupp, J. L. Abbott, V. S. Frost, and E. E. Komp Sep. 1977 277 p refs
(Contract DAAG53-76-C-0154)
(AD-A053253; RSL-TR-319-27-Vol-1; ETL-0117-Vol-1) Avail: NTIS HC A13/MF A01 CSCL 17/9

The purpose of this report is to present the validation of the Point Scattering Radar Image Simulation Model and its software implementation developed at RSL (Remote Sensing Laboratory, University of Kansas, Lawrence, Kansas). The work was sponsored by ETL (Engineer Topographic Laboratories, U.S. Army, Fort Belvoir, Virginia). Two different instances of model validation are reported. First is validation of both SLAR Side-Looking Airborne Radar) and PPI (Plan-Position Indicator) radar simulation models by comparison of simulations to real images (of exactly the same ground swath) having the same look direction and other flight parameters. Second is a quantitative validation of a PPI model specialized to making reference scenes for a terminal guidance system using the Correlatron. The results obtained have shown the simulated radar images to be accurate representations of the ground scenes at the microwave frequencies they modeled. The comparisons were shown to be very favorable. Preliminary results of the guidance test have been very satisfactory. Data base construction techniques are also discussed. Alternate input intelligence data sources (high-resolution aerial photographs, maps, infrared) for feature extraction are reviewed. A conceptual design for an interactive feature extraction system is discussed. Author (GRA)

N78-26353# Georgia Inst. of Tech., Atlanta. Electromagnetics Lab.
INVESTIGATION OF MILLIMETER WAVE AND FAR INFRARED MULTIWAVELENGTH SYSTEMS Interim Technical Report
G. R. Loefer and R. G. Shackelford 22 Feb. 1978 21 p
(Contracts DAAG29-77-C-0026; N00014-75-C-0320; GT Proj. A-1985)
(AD-A053172; ARO-15277.1-A-P) Avail: NTIS HC A02/MF A01 CSCL 17/5

Under a previous contract, a series of tests were performed in an effort to define some of the working characteristics of the 70 GHz radar and to investigate some of the problems involved with 'handover' from the radar to an electro-optical (EO) sensor system. These experiments are discussed in this report. An EO system with the desired performance can be realized with a 5 watt CW laser. With direct detection, the performance margin is low even in high visibility atmospheric conditions; however, with heterodyne detection, adequate SNR will exist to compensate for losses in the optical system, and atmospheric losses associated with low to moderate visibility conditions. Author (GRA)

N78-26354# Control Data Corp., Minneapolis, Minn. Digital Image Systems Div.
REAL-TIME CLASSIFICATION OF RADAR CHANGES Final Technical Report, May 1976 - Jun. 1977
L. Kirvida, M. Murphy, and B. Winston Griffiss AFB, N. Y. RADC Mar. 1978 150 p ref
(Contract F30602-76-C-0239; AF Proj. 6244)
(AD-A053177; RADC-TR-78-29) Avail: NTIS HC A07/MF A01 CSCL 05/5

This report contains the results of a study of different methods of radar change detection. Four techniques were investigated, all as related to pixel-by-pixel processing. The results were compared to the previously developed techniques of straight correlation registration and absolute difference thresholding for change detection. The four techniques included registration of compressed data, gradient images, object boundary images, and

strong return images. The strong return techniques demonstrated the most promise. Author (GRA)

N78-26355# Purdue Univ., Lafayette, Ind. School of Engineering.
EFFECTS OF HORIZONTAL GROUND WIRES ON LOW ANGLE RADIATION FROM HF ANTENNAS Final Report, Dec. 1975 - Dec. 1977
C. L. Chen and W. L. Weeks Griffiss AFB, N. Y. RADC Feb. 1978 21 p
(Contract F19628-76-C-0086; AF Proj. 2305)
(AD-A053210; RADC-TR-78-45) Avail: NTIS HC A02/MF A01 CSCL 09/5

Digital computer programs have been developed to evaluate the effects of horizontal ground wire systems on the low angle radiation from vertically polarized HF antennas. An extensive method of moments program (WF-LLL2A) has been modified for this purpose. An alternative approximate method has also been studied and the results compared. Results indicate the feasibility of these types of calculations and that a low angle field enhancement of 20 to 25 % by design of the ground wire system may be possible at the higher frequencies in the HF band, but that larger ground screens do not necessarily give greater enhancements. The effect of backscreen reflector size was also studied. Author (GRA)

N78-26356# Rome Air Development Center, Griffiss AFB, N.Y.
VLF/LF REFLECTIVITY OF THE POLAR IONOSPHERE, 1 MAY - 3 SEPTEMBER 1977
John E. Rasmussen, John P. Turtle, Robert P. Pagliarulo, and Wayne L. Klemetti Dec. 1977 85 p refs
(AD-A053236; RADC-TR-77-428) Avail: NTIS HC A05/MF A01 CSCL 20/14

This report provides a summary of high latitude ionospheric reflectivity as observed by the USAF high resolution VLF/LF ionosounder operating in northern Greenland. Ionospheric reflectivity parameters, including reflection heights and coefficients, are presented as a function of time of day. VLF long path propagation measurements, along with magnetometer and riometer data, are presented as supplementary information. Author (GRA)

N78-26357# Rome Air Development Center, Griffiss AFB, N.Y.
BEAM DEFLECTION CAUSED BY ANTENNA PHASE ERRORS
Ronald L. Fante Feb. 1978 10 p refs
(AF Proj. 2305)
(AD-A053209; RADC-TR-78-41) Avail: NTIS HC A02/MF A01 CSCL 17/2

The mean square beam deflection, which is produced by random phase errors across an antenna was calculated. It was found that the angular beam deflection theta sub c = 17.7(delta/lambda)(a/L) theta sub B, where delta is the tolerance error on the height of the surface imperfections, a is the transverse correlation length of the surface imperfections, L is the antenna size, lambda is the wavelength, and theta sub B is the beamwidth. GRA

N78-26358# Naval Research Lab., Washington, D. C. Target Characteristics Branch.
REFLECTIVE BUTLER MATRICES Interim Report
J. Paul Shelton and James K. Hsiao 14 Mar. 1978 31 p refs
(RR0210541)
(AD-A053357; NRL-8188) Avail: NTIS HC A03/MF A01 CSCL 09/5

A conventional Butler matrix can be modified to achieve a network which is symmetric about an axis midway between the input and output lines. Such a Butler matrix network can be cut in that plane of symmetry so that the input and output ports are identical. In this manner, the half-matrix corresponds to a reflection-type system in which the feed positions are in the aperture region. This report describes the modifications which symmetrize the Butler matrix and the method for cutting the network on the symmetry plane so as to achieve a reflective matrix. A computer program which generates and plots this network is presented. Author (GRA)

N78-26359# SRI International Corp., Menlo Park, Calif.
CHATANIKA MODEL OF THE HIGH LATITUDE IONOSPHERE FOR APPLICATION TO HF PROPAGATION PREDICTION Final Report, 1 Jan. - 30 Sep. 1977
R. R. Vondrak, G. Smith, V. E. Hatfield, R. T. Tsunoda, and V. R. Frank Jan. 1978 158 p refs
(Contract F19628-77-C-0102)
(AD-A053154; RADC-TR-78-7) Avail: NTIS HC A08/MF A01 CSCL 17/9

Electron density measurements made with the incoherent-scatter radar at Chatanika, Alaska have been used to obtain a synoptic model of the high-latitude ionosphere. This Chatanika model is a modification of the RADC-POLAR model developed by Elkins and coworkers for use in raytracing codes for HF propagation prediction. Because the existing RADC model was derived from a larger and more geographically extensive data base than that used in this study, many of its features have been retained in the new model. The major modification made was an improved specification of the auroral E-layer and the altitude interval between the E and F regions. This region sometimes acts as a duct in which HF signals may travel for great distances without traversing the D region, where most absorption occurs. GRA

N78-26360# Syracuse Univ., N. Y. Dept. of Electrical and Computer Science.
APPLICATIONS OF MATRIX METHODS TO RADIATION AND SCATTERING SYSTEMS Final Report, 15 Aug. 1976 - 30 Sep. 1977
Joseph R. Mautz and Roger F. Harrington Jan. 1978 96 p refs
(Contract F19628-76-C-0300)
(AD-A053193; RADC-TR-78-16) Avail: NTIS HC A05/MF A01 CSCL 20/3

The problem of plane-wave scattering by a homogeneous material body of revolution is considered. A solution is obtained by applying the method of moments to a coupled pair of integral equations. The quantities determined are the equivalent surface electric and magnetic currents, and the scattered far field. A general computer program is given and documented, with sample input-output data. Other reports published on this project are summarized, and recommendations are made for future work. Author (GRA)

N78-26361# Fondazione Ugo Bordoni, Rome (Italy). Centro Onde Millimetriche.
DESIGN PRODUCTION AND MEASUREMENTS OF A CONTINUOUS CIRCULAR MILLIMETER WAVEGUIDE
Paolo Bernardi, Gabriele Falciasecca, Giorgio Grasso, G. Luoni, and Francesco Valdoni 1977 10 p refs Presented at the EUROCON 77 Meeting, Venice, 3-7 May 1977 Prepared jointly with Ind. Pirelli
(FUB-8-1977) Avail: NTIS HC A02/MF A01

The first stages of development of a flexible waveguide to be used as transmission medium in a communication system are presented together with the procedure followed to improve the performance of the waveguide. It was concluded that development of the flexible waveguide is not complete: some installation problems remain to be solved; and the electromagnetic structure must be changed according to results obtained as power spectra of the imperfections and following the procedure already shown, but with correlation of geometrical deformations and electromagnetic characteristics. ESA

N78-26362# Physics Lab. RVO-TNO, The Hague (Netherlands).
RESULTS OF DATA TRANSMISSION TRIALS PERFORMED BY THE NETHERLANDS FOR FINABEL INDIA
H. G. M. Bennis and J. P. Smit Jan. 1977 79 p In FRENCH; ENGLISH summary
(Contract A65/KL/082)
(PhL-1977-03; TDCK-68820) Avail: NTIS HC A05/MF A01

Results of the trials, performed on a VHF circuit, are given. These results will be compiled by Finabel, India, in a final report, together with the results of the other contributing countries. Author (ESA)

N78-26363# Physics Lab. RVO-TNO, The Hague (Netherlands).
DEVELOPMENT OF AN ANGULAR ESTIMATION ALGORITHM

F. B. Rijsdijk Jan. 1977 81 p refs
(PhL-1977-04; TDCK-68821) Avail: NTIS HC A05/MF A01

A description and the results of the study are given. In the experimental phased-array radar system FUCAS a monopulse facility is used to obtain two-dimensional angular information on a target. This information is contained in the three output signals of the multimode feedhorn of the antenna if the target is within the 3 db-contour of the main beam. By processing on the amplitude of these signals the target direction relative to the beam axis can be estimated. The requirements of the algorithm, its accuracy, the coordinate system, and the measuring problems are discussed. Author (ESA)

N78-26364# Physics Lab. RVO-TNO, The Hague (Netherlands).
DESCRIPTION OF ALPHA-BETA TRACKING FILTER WITH MINIMAL MAXIMUM TRANSIENT ERROR RESPONSE
A. M. Navarro Mar. 1977 42 p refs
(PhL-1977-13; TDCK-69058) Avail: NTIS HC A03/MF A01

An alpha-beta filter is described which has to be used in a phased-array radar system. The filter is designed in such a manner that the probability of threshold excursion of the tracking error is kept below a certain, small, value. For the maneuver errors no probabilistic model, but a deterministic maneuver model was chosen which has typical properties with respect to the maximal tracking errors which occur. Author (ESA)

N78-26365# Physics Lab. RVO-TNO, The Hague (Netherlands).
EFFECTS OF DETECTOR BANDWIDTH REDUCTION ON LIDAR SIGNAL PROCESSING
G. J. Kunz and J. P. vanderMeulen Jun. 1977 37 p refs
(PhL-1977-31; TDCK-69505) Avail: NTIS HC A03/MF A01

Possible error spurces introduced by the detection of lidar signals may be the length of the transmitted laser pulse and the electrical bandwidth of the receiver. Since, up to now no literature has been available, an investigation was made of the above mentioned error sources. It was proven that by using laser pulses as small as 20 ns FWHM, and a lidar that rates the signal after about 0.5 microsecond after transmitting the laser pulse, only very small errors appear. Using a receiver with limited bandwidth, unexpected serious errors are introduced in, e.g., the extinction coefficient derived from the measured signals. It is pointed out that an introduction of a time shift will compensate for this error. Author (ESA)

N78-26366# Physics Lab. RVO-TNO, The Hague (Netherlands).
MTI PARAMETERS FOR FUCAS
P. J. A. Prinsen Jun. 1977 25 p refs
(Contract A74/K/077)
(PhL-1977-34; TDCK-69596) Avail: NTIS HC A02/MF A01

Three sets of numerical values for the MTI parameters (pulse spacings and weights of the staggered prf MTI filter) for FUCAS are given (3, 4, and 5 pulse canceller). In order to find these parameters the spacings and weights are adjusted in an interactive way, such that the blind speed response, relative to white noise gain, was maximized to about -9 db, while on the other hand the improvement factor was kept above a level of 33 db (in each set for a specified type of clutter), which level is achievable with the actual system. Author (ESA)

N78-26367# Physics Lab. RVO-TNO, The Hague (Netherlands).
SOME THEORETICAL ASPECTS OF THE PHOTO-DETECTION PROCESS. A TUTORIAL APPROACH
H. Dekker Aug. 1977 29 p refs
(PhL-1977-43; TDCK-69739) Avail: NTIS HC A03/MF A01

Coherent heterodyne detection in the optical range of the electromagnetic spectrum is a relatively new technique. The usual device for measuring these optical fields essentially involves a quantum mechanical process, namely, photo-electron excitation, for example from the valence to the conduction band in a semiconductor. In a more or less tutorial manner the underlying theoretical aspects of coherent detection are clarified and some remarks are made concerning present day photo-electron counting techniques. Author (ESA)

N78-26368# Physics Lab. RVO-TNO, The Hague (Netherlands).
A SIMPLE AND FAST MATCHING METHOD FOR MUTUAL COUPLING OF A LINEAR PHASED ARRAY ANTENNA WITH WAVEGUIDE APERTURES AS RADIATING ELEMENTS
J. Snieder Jul. 1977 43 p refs
(PhL-1977-37; TDCK-69740) Avail: NTIS HC A03/MF A01

For three different linear arrays it is shown that a match to free space of each array element in its surroundings will result in a compensation for mutual coupling the effect of which is approximately the same as a match at a scan angle about halfway the scan interval. For all three cases, the remaining loss percentage, averaged over all scan angles of the scan interval, is a few percent and this value is only about 0.3% higher than the minimum calculated value. Use is made of measured coupling coefficients. The loss percentage was also measured directly and turned out to be a little lower than the calculated values. Matching the elements to free space can be done simply and quickly.
Author (ESA)

N78-26369# Urban Inst., Washington, D.C. Cable Television Information Center.
THE 5TH ANNUAL TELECOMMUNICATIONS POLICY RESEARCH CONFERENCE, VOLUME 1
1977 407 p refs Conf. held at Airlie, Va., 30 Mar. - 2 Apr. 1977 Sponsored in part by FCC, Office of Telecommunications Policy, and John and Mary Markle Foundation 2 Vol.
(Grant NSF APR-77-00164)
(PB-277435/4; NSF/RA-770398) Avail: NTIS HC A18/MF A01 CSCL 17B

Topics discussed include: (1) communications indicators (2) innovative service technologies (3) revision of the 1934 Communication Act (4) the limits of television in relation to its artistic, educational, sociological, and informative potential; (5) United States policy on international telecommunications (6) dimensions in radio spectrum management and (7) domestic satellite policy in terms of the delivery of rural communications by satellite, the use of small earth stations, and intelsat and domestic satellite systems. GRA

N78-26370# Urban Inst., Washington, D.C. Cable Television Information Center.
THE 5TH ANNUAL TELECOMMUNICATIONS POLICY RESEARCH CONFERENCE, VOLUME 2
1977 425 p refs Conf. held at Airlie, Va., 30 Mar. - 2 Apr. 1977 Sponsored in part by FCC, Office of Telecommunications Policy, and John and Mary Markle Foundation 2 Vol.
(Grant NSF APR-77-00164)
(PB-277436/2; NSF/RA-770399) Avail: NTIS HC A18/MF A01 CSCL 17B

Critical issues relevant to telecommunications addressed include: (1) fairness in advertising aimed at children, and facts and values in children's advertising regulation; (2) the idea of a policy research agenda clearing-house; (3) television's effect on political behavior; (4) recent empirical work in common carrier regulation; (5) pricing and cost allocation and multi-part tariffs; (6) telecommunications policy in relation to issues of professionalism and impact; (7) social services delivery roles for telecommunications in the criminal justice system; and (9)regulation, invention, and innovation in terms of resources allocation in agencies with diverse responsibility and the relationship between innovation and market structure. GRA

N78-26371# Stanford Univ., Calif. Communications Satellite Planning Center.
UHF TASK FORCE REPORT: SPECTRUM-EFFICIENT TECHNOLOGY FOR VOICE COMMUNICATIONS. 1: SUMMARY AND IMPLICATIONS. 2: EVALUATION OF MODULATION AND VOICE PROCESSING TECHNIQUES FOR LAND MOBILE RADIO
Raymond M. Wilmotte and Bruce B. Lusignan Washington FCC Feb. 1978 54 p ref Audio tape included with hard copy only
(Contract FCC-0245-8)
(PB-278340/5; FCC/OPP/UTF-78-01) Avail: NTIS HC E05/MF A01 CSCL 17B

It is shown that from seven to 10 times more channels can be created in existing mobile radio bands using a narrow-band system which employs single sideband modulation and two small devices: an amplitude compandor, which increases the quality of a signal, and a frequency compandor, which reduces the base bandwidth of voice. This spectrum-efficient technology made it

possible to transmit voice signals using a channel bandwidth of 2.5 kHz. GRA

N78-26372# Institute for Telecommunication Sciences, Boulder, Colo.
NOISE POWER DUE TO DIGITAL ERRORS IN A PCM TELEPHONE CHANNEL
Hiroshi Akima Jan. 1978 39 p refs
(PB-277447/9; OTR-78-139) Avail: NTIS HC A04/MF A01 CSCL 17B

Errors in digital transmission in a PCM telephone channel result in additional noise power at the receiver output. The relation between the noise power and the BER (bit-error rate) is calculated for three types of assumed signal distributions for a wide range of signal levels, for both the A-law and u-law compandings with several companding parameter values for each, for the 7-bit and 8-bit quantizings, and for two coding schemes. The calculated results indicate that, in a practical range of the signal level and for the second coding scheme (i.e., the absolute-value coding with a sign bit), the noise power does not exceed 10,000 pWOp, 50,000 pWOp, and 1,000,000 pWO if the BER equals 0.00001, 0.00005, and 0.0003, respectively. GRA

33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics*.

N78-26373*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MEDIUM POWER VOLTAGE MULTIPLIERS WITH A LARGE NUMBER OF STAGES
W. T. Harrigill and I. T. Myers Jun. 1978 8 p refs Presented at Power Electron. Specialists Conf., Syracuse, N. Y., 13-15 Jun. 1978; sponsored by IEEE
(NASA-TM-78900; E-9636) Avail: NTIS HC A02/MF A01 CSCL 10C

Voltage multiplier techniques are extended at medium power levels to larger multiplication ratios. A series of dc-dc converters were built, with from 20 to 45 stages and with power levels up to 100 watts. Maximum output voltages were about 10,000 volts. Author

N78-26374*# University of South Florida, Tampa. Coll. of Engineering.
COMPUTERIZED POWER SUPPLY ANALYSIS: STATE EQUATION GENERATION AND TERMINAL MODELS Final Report, 2 Feb. 1976 - 2 Apr. 1978
S. J. Garrett 1978 123 p refs
(Grant NsG-3096)
(NASA-CR-157240) Avail: NTIS HC A06/MF A01 CSCL 09C

To aid engineers that design power supply systems two analysis tools that can be used with the state equation analysis package were developed. These tools include integration routines that start with the description of a power supply in state equation form and yield analytical results. The first tool uses a computer program that works with the SUPER SCEPTRE circuit analysis program and prints the state equation for an electrical network. The state equations developed automatically by the computer program are used to develop an algorithm for reducing the number of state variables required to describe an electrical network. In this way a second tool is obtained in which the order of the network is reduced and a simpler terminal model is obtained. B.B.

N78-26375# Royal Aircraft Establishment, Farnborough (England).
A NEW POLARIZER CIRCUIT FOR INFLUENCE AND CAPACITOR MACHINES
H. Wommelsdorf and M. J. Buckingham, ed. Dec. 1977 11 p refs Transl. into ENGLISH from Ann. Phys. (Leipzig), v. 63, 4th series, 1920 p 295-300
(RAE-Lib-Trans-1947; BR62773) Avail: NTIS HC A02/MF A01

A capacitor machine, suitable for teaching purposes, was constructed so that as many parts as possible lay open to inspection at any time. The rotatable polarizer, well insulated from its supporting block, has a switch to adjust the variable setting of available air resistance. The correct setting of the switch, which changes with the prevailing discharge voltages or spark lengths, permits increased efficiency of the influence or capacitor machine. By inserting a conducting connection between the left electrode and the upper part of the polarizer, and between the right electrode and the lower part of the polarizer, a 25% increase in the current intensity was achieved. A.R.H.

N78-26376*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A QUICK RESPONSE FOUR DECADE LOGARITHMIC HIGH-VOLTAGE STEPPING SUPPLY
Henry Doong Apr. 1978 25 p refs
(NASA-TM-79547) Avail: NTIS HC A02/MF A01 CSCL 09A

An improved high-voltage stepping supply, for space instrumentation is described where low power consumption and fast settling time between steps are required. The high-voltage stepping supply, utilizing an average power of 750 milliwatts, delivers a pair of mirror images with 64 level logarithmic outputs. It covers a four decade range of + or - 2500 to + or - 0.29 volts having an output stability of + or - 0.5 percent or + or - 20 millivolts for all line load and temperature variations. The supply provides a typical step setting time of 1 millisecond with 100 microseconds for the lower two decades. The versatile design features of the high-voltage stepping supply provides a quick response staircase generator as described or a fixed voltage with the option to change levels as required over large dynamic ranges without circuit modifications. The concept can be implemented up to + or - 5000 volts. With these design features, the high-voltage stepping supply should find numerous applications where charged particle detection, electro-optical systems, and high voltage scientific instruments are used. L.S.

N78-26377# Aerospace Corp., El Segundo, Calif.
MINUTES OF THE MEETING FOR MICROCIRCUIT MANUFACTURERS ON THE NEW CLASS S SPACE PARTS DOCUMENTATION Final Report
Miles M. Metfessel 15 Jan. 1978 125 p Meeting held at El Segundo, Calif., 15 Dec. 1977
(Contract F04701-77-C-0078)
(AD-A052842; TR-0078(3902)-1; SAMSO-TR-78-72) Avail: NTIS HC A06/MF A01 CSCL 09/5

This report presents the minutes of a technical information interchange meeting, which was open to all microcircuit manufacturers interested in the new Class S documents developed by the Air Force Space and Missile Systems Organization (SAMSO) and the National Aeronautics and Space Administration (NASA). This meeting was held 15 December 1977 at The Aerospace Corporation, El Segundo, California. Representatives of SAMSO, NASA, the Defense Electronics Supply Center (DESC) and The Aerospace Corporation made presentations and answered questions on the scope and intent of the new Class S specification and procedural publications. The initial Class S space parts standards, specifications, and guidelines were provided to the industry participants prior to the meeting and were the following: MIL-M-38510D, 31 August 1977, 'Microcircuits, General Specifications for;' MIL-STD-976, 31 August 1977, 'Certification Requirements for JAN Microcircuits;' and DESC-EQE-44, First Draft, 18 November 1977, 'Guidelines for the Implementation of Class S Microcircuit Certification.' Author (GRA)

N78-26378# Missouri Univ., Rolla. Dept. of Electrical Engineering.
ACTIVE-R BANDPASS FILTER DESIGN USING HYBRID-PI TRANSISTOR MODEL Final Report. M.S. Thesis
Lester C. Roth 20 Mar. 1978 79 p refs
(AD-A053144) Avail: NTIS HC A05/MF A01 CSCL 09/5

A design procedure is developed for a bandpass filter utilizing five bipolar transistors and no external capacitors. Base resistors of a three-stage amplifier are used to set a third-order open-loop

pole at a location given in terms of the center frequency and bandwidth of the filter. A feedback resistor, also given in terms of the center frequency and bandwidth, is then used to move the poles to the final location. A test circuit is constructed and compared with a computer simulation. Limitations of the circuit are discussed. Author (GRA)

N78-26379# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.

[RESEARCH PROGRESS IN GENERAL PHYSICS, PLASMA DYNAMICS, AND COMMUNICATION ENGINEERING] Annual Report, 1 Jan. - 31 Dec. 1977

P. A. Wolff and J. Allen Jan. 1978 199 p
(Contract DAAB07-76-C-1400)
(AD-A052892; PR-120) Avail: NTIS HC A09/MF A01 CSCL 09/3

This report, No. 120 in a series of progress reports issued by the M.I.T. Research Laboratory of Electronics, reviews the research progress and states the research objectives of the laboratory for the year ending December 31, 1977. The source of support is indicated for each project. Author (GRA)

N78-26380# National Bureau of Standards, Washington, D. C. Inst. for Materials Research.

DEVELOPMENT, TESTING, AND EVALUATION OF MHD-MATERIALS Quarterly Report, July - Sep. 1977

H. P. Frederikse, T. Negas, and S. J. Schneider 30 Sep. 1977 76 p refs
(Contract EA-77-A-01-6010-035)
(FE/6010-9) Avail: NTIS HC A05/MF A01

During this quarter preparations went forward for the testing of an electrode/insulator assembly in the U-02 facility under auspices of the US-USSR cooperative program on MHD power generation (Phase 3). Samples of various electrode materials to be used in this test were received for determination of their electrical conductivity. Some 60 materials were analyzed by X-ray diffraction with regard to crystallinity and phase composition. Further progress was made on the seed-slag interaction problem by mapping major sections of the phase diagram for the system K2O-CaO-Al2O3-SiO2. Characterization of six electrodes tested in the MIT rig was completed. Samples of chrome-magnesia, tested for 30 hrs in a seed environment, were examined by means of X-ray diffraction and Scanning Electron Microscopy. A list was compiled of references to property data for some 20 stainless steels and alloys which show promise for use in downstream components of MHD systems. ERA

N78-26381# Oak Ridge National Lab., Tenn.

ELECTRIC GENERATORS: ROESEL

C. L. Segaser Apr. 1977 42 p refs
(Contract W-31-109-eng-38)
(ANL/CES/TE-77-3) Avail: NTIS HC A03/MF A01

An electrical generator is described that will provide constant frequency output (within 0.01% or better) regardless of rotational speed variations. It accomplishes this with no added bulk over conventional generators, and with excellent efficiency. The same principle that permits constant frequency output also provides the means for output voltage regulation with varying drive speed and/or varying load. Onsite power generation aspects of the Integrated Community Energy Systems (ICES) concept include the requirement to follow community electric loads and the possible use of internal combustion piston engines with waste heat recovery to drive electric generators. The diesel engine is a prime candidate from commercially available technologies for which part load shaft efficiency is better at reduced speed than for constant speed operation required by conventional ac generators. ERA

N78-26382# Toulouse Univ. (France). Lab. de Genie Electrique.

[ACTIVITIES OF THE DIELECTRIC MATERIALS GROUP] Scientific Report, Jul. 1977

Jul. 1977 66 p refs In FRENCH
(ERA-299) Avail: NTIS HC A04/MF A01

The subjects dealt with are: interaction between discharges and insulating surfaces, characterization of solid insulators, insulators under extreme conditions, and transport phenomena in solid insulators. ESA

N78-26383# Technological Lab. RVO-TNO, Rijswijk (Netherlands).

STATIC CHARGING OF COVERALLS WITH 'ADHESIVE FASTENERS' [STATISCHE OPLADING VAN OVERALLS MET KLEEFBAND SLUITINGEN]

H. J. vanGeffen 14 Mar. 1977 15 p refs In DUTCH
(Contract A76/KLu/133)
(TL-1977-7; TDCK-69177) Avail: NTIS HC A02/MF A01

The extent to which coveralls with adhesive fasteners can lead to dangerous situations during the inspection and repair of rubber internal aircraft tanks was investigated. It is concluded that such coveralls do not give rise to dangerous situations. A comparative investigation with conventional coveralls did not reveal any clear distinction in electrostatic behavior of either type of coveralls. ESA

N78-26384# Laboratorio di Ricerca e Technologia per lo Studio del Plasma nello Spazio, Frascati (Italy).

MATCHING OF A PIEZOELECTRIC TRANSDUCER TO A GRAVITATIONAL WAVE ANTENNA

G. V. Pallottino and G. Pizzella (Rome Univ.) Nov. 1977 14 p refs
(LPS-77-25) Avail: NTIS HC A02/MF A01

The optimum design of a gravitational wave experiment requires a proper matching of the various subsystems in order to obtain the best sensitivity when the main characteristics of the antenna, such as its size, are predetermined by a priori technical constraints. Two algorithms of data analysis were considered, Gibbons-Hawking and Wiener, their implications are discussed on the matching at the level of the transducer. The solution of the matching problem provides the optimum arrangement of the ceramics and of the transistors in the preamplifier. Author (ESA)

N78-26385# Pusat Penyelidikan Masalah Kelistrikan, Djakarta (Indonesia).

TECHNICAL FORUM ON DIRECT CURRENT TRANSMISSION

1977 328 p Forum held in Djakarta, Indonesia, 18-19 Oct. 1976; sponsored by the Technol. Transfer Inst., Tokyo, and EPDC Intern. Ltd., Tokyo
(PB-277769/6; LMK-03-EP-77) Avail: NTIS HC A15/MF A01 CSCL 10B

An outline of the following is presented: (1) High voltage dc transmission; (2) Equipment and components of direct current transmission systems; (3) Prospects for Indonesia; (4) Transmission line; and (5)dc cable and accessories. Author

N78-26386# Electricity Council Research Center, Capenhurst (England).

ELECTRIC HEATING FOR PRESSURE DIE CASTING NOZZLES

R. Stevens Oct. 1977 17 p refs
(PB-277433/9; ECRC/M-1084) Avail: NTIS HC A02/MF A01 CSCL 13A

The possibility of using electric heating of magnesium pressure die casting nozzles was investigated. Temperature calculations were carried out which indicated its feasibility. A test rig was built and temperature gradients in a full size nozzle were measured. The results suggest that resistance heating of the nozzle is possible. A life test of the resistance heater gave a satisfactory result. GRA

N78-26064*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

AIRLINE PILOT SCANNING BEHAVIOR DURING APPROACHES AND LANDING IN A BOEING 737 SIMULATOR

Amos A. Spady, Jr. *In* AGARD Guidance and Control Design Considerations for Low-Altitude and Terminal-Area Flight Apr. 1978 5 p refs (For availability see N78-26049 17-01)
Avail: NTIS HC A14/MF A01 CSCL 05J

34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics*.

N78-26387 Tennessee Univ., Knoxville.
EFFECT OF TRANSITION ZONE AND NONADDITIVITY CONTRIBUTION ON SURFACE TENSION AND SURFACE ENERGY OF LIQUID ARGON NEAR THE TRIPLE POINT Ph.D. Thesis
Yea-Hwang Uang 1977 186 p
Avail: Univ. Microfilms Order No. 78-07730

Quantities are calculated from the extended formulas, based on the classical statistical mechanics, for the cases of a linear, a cubic, and a Fermi density profile. Several approximate representations of the radial distribution function are introduced in the transition zone. It is shown that the radial distribution function in the interface region cannot be appropriately obtained by interpolation between that in the bulk liquid and that in the bulk vapor for most part of the regions in the transition zone. The nonadditivity contribution to the surface energy is derived as an integral involving intermolecular potentials and molecular distribution functions. A sextuple integral to obtain the three-bodied correction to the surface energy can be calculated, which is about -2.4 + or -0.1 erg/sq cm for liquid argon at 85 K. The transition zone width can be determined approximately from the experimental value of the surface energy. Dissert. Abstr.

N78-26388 Minnesota Univ., Minneapolis.
PAIR-PAIR CORRELATIONS IN SIMPLE FLUIDS Ph.D. Thesis
Francis John Pinski 1977 133 p
Avail: Univ. Microfilms Order No. 78-09724

Correlations in a fluid between pairs of spherically symmetric atoms are calculated for room temperature Argon and the quantum ground state of He-4. These correlations are studied through a distribution function. An approximate integral equation is derived for this pair-pair distribution function. The important aspects of the derivation include the use of the normalization integral (of a wave function) as a generating function. A function derivative is then applied to an approximation for the pair distribution function to obtain the integral equation. The pair-pair distribution is needed in the theory of second order light scattering (or Raman scattering). The Monte Carlo method is described and used to calculate the pair-pair correlation function for the quantum ground state of He-4. An integral equation for the three particle correlation function is derived. A solution for the three particle distribution function is found only in the low density limit. Dissert. Abstr.

N78-26389*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
LASER VELOCIMETER APPLICATION TO OSCILLATORY LIQUID FLOWS
Luther R. Gartrell May 1978 24 p refs
(NASA-TM-78702) Avail: NTIS HC A02/MF A01 CSCL 20D

A laser velocimeter technique was used to measure the mean velocity and the frequency characteristics of an oscillatory flow component generated with a rotating flapper in liquid flow system at Reynolds numbers approximating 93,000. The velocity information was processed in the frequency domain using a tracker whose output was used to determine the flow spectrum. This was accomplished with the use of an autocorrelator/Fourier transform analyzer and a spectrum averaging analyzer where induced flow oscillations up to 40 Hz were detected. Tests were conducted at a mean flow velocity of approximately 2 m/s. The experimental results show that the laser velocimeter can provide quantitative information such as liquid flow velocity and frequency spectrum with a possible application to cryogenic fluid flows.
Author

N78-26390*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LITHIUM AND POTASSIUM HEAT PIPES FOR THERMIONIC CONVERTERS
Gabor Miskolczy (Thermo Electron Corp., Waltham, Mass.) and Erich Kroeger 1978 7 p refs Proposed for presentation at the 13th Intersociety Energy Conversion Engr. Conf., San Diego, Calif., 20-25 Aug. 1978; sponsored by SAE, ACS, AIAA, ASME, IEEE, AICHE, and ANS
(Contract NAS3-20270)
(NASA-TM-78946; E-9695) Avail: NTIS HC A02/MF A01 CSCL 20D

A prototypic heat pipe system for an out-of-core thermionic reactor was built and tested. The emitter of the concentric thermionic converter consists of the condenser of a tungsten heat pipe utilizing a lithium working fluid. The evaporator section of the emitter heat pipe is radiation heated to simulate the thermal input from the nuclear reactor. The emitter heat pipe thermal transport is matched to the thermionic converter input requirement. The collector heat pipe of niobium, 1% zirconium alloy uses potassium as the working fluid. The thermionic collector is coupled to the heat pipe by a tapered conical joint designed to minimize the temperature drop. The collector heat flux matches the design requirements of the thermionic converter. Author

N78-26391*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SOLUTION OF TRANSONIC FLOWS BY AN INTEGRO-DIFFERENTIAL EQUATION METHOD
Wandera Ogana (Nairobi Univ., Kenya) Jun. 1978 30 p refs
(NASA-TM-78490; A-7434) Avail: NTIS HC A03/MF A01 CSCL 20D

Solutions of steady transonic flow past a two-dimensional airfoil are obtained from a singular integro-differential equation which involves a tangential derivative of the perturbation velocity potential. Subcritical flows are solved by taking central differences everywhere. For supercritical flows with shocks, central differences are taken in subsonic flow regions and backward differences in supersonic flow regions. The method is applied to a nonlifting parabolic-arc airfoil and to a lifting NACA 0012 airfoil. Results compare favorably with those of finite-difference schemes.
Author

N78-26392*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
INDUCED VELOCITY FIELD OF A JET IN A CROSSFLOW
Richard L. Fearn (Florida Univ., Gainesville) and Robert P. Weston May 1978 148 p refs
(NASA-TP-1087; L-11624) Avail: NTIS HC A07/MF A01 CSCL 20D

An experimental investigation of a subsonic round jet exhausting perpendicularly from a flat plate into a subsonic crosswind of the same temperature was conducted. Velocity and pressure measurements were made in planes perpendicular to the path of the jet for ratios of jet velocity to crossflow velocity ranging from 3 to 10. The results of these measurements are presented in tabular and graphical forms. A pair of diffuse contrarotating vortices is identified as a significant feature of the flow, and the characteristics of the vortices are discussed.
Author

N78-26393# Utah State Univ., Logan. Dept. of Chemistry and Biochemistry.
DESIGN AND FABRICATION OF A PROTOTYPE COLD BACKGROUND EXPERIMENTAL REACTION CHAMBER AND SPECTRAL DETECTION SYSTEM Final Report, 4 May 1972 - 30 Sep. 1977
William M. Moore 31 Dec. 1977 82 p refs
(Contract F19628-72-C-0317)
(AD-A053208; AFGL-TR-77-0306) Avail: NTIS HC A05/MF A01 CSCL 20/4

The design and fabrication of a low temperature chemical reaction chamber was successfully completed. A spectral detection system to observe chemiluminescence in the infrared was also completed. Sample spectra taken in the finished chamber are shown to demonstrate the potential application of the apparatus. The optical components present at the time of the project completion date permitted spectral detection to 12 micrometers. Several detection schemes have been examined to measure atomic and molecular species in the reaction chamber or from the exhaust gas. Mass spectrometry appears to be very promising in cases where molecular beams can be modulated and ion counting

techniques are employed. A nonlinear response for the molecular species of ozone has limited the usefulness of positive ion mass spectrometry. A new technique for measuring atomic oxygen in situ has been developed, but the sensitivity is not comparable to that for the infrared emission from atomic oxygen reactions in the low temperature Cochise facility. Negative surface ionization has potential advantages for some of species of interest and this technique is under further development. GRA

N78-26394# Pennsylvania State Univ., University Park. Applied Research Lab.
PREDICTION OF BODY TEMPERATURE DISTRIBUTION, LAMINAR SEPARATION, AND TRANSITION IN THE PRELIMINARY DESIGN OF HEATED UNDERWATER BODIES
J. J. Eisenhuth 22 Feb. 1978 82 p refs
(Contract N00017-73-C-1418)
(AD-A053254; TM-78-39) Avail: NTIS HC A05/MF A01 CSCL 20/4

Because of the interest in predicting the characteristics of laminar, heated, water boundary layers, an existing code was adapted for use on an IBM 370 computer and extended to include the axisymmetric case. The similar type solutions of the boundary layer equations made it possible to perform a parametric study and to use the results in developing a means for specifying a stabilizing temperature distribution on a body. Additional studies into the effect of temperature on laminar separation and transition have resulted in simplified criteria for predicting these phenomena. GRA

N78-26395# Naval Academy, Annapolis, Md. Div. of Engineering and Weapons.
AN EXPERIMENTAL STUDY OF TURBULENT BOUNDARY LAYER WITH SLIT SUCTION Final Report, Jun. 1976 - Dec. 1977
Sander M. Calisal Mar. 1978 48 p refs
(AD-A052871; USNA-EW-5-78) Avail: NTIS HC A03/MF A01 CSCL 20/4

Experiments are performed on a flat plate with suction slit. Mean Velocity profiles, RMS values are measured with hot wire anemometry. Friction velocity is numerically calculated. GRA

N78-26396# Air Force Geophysics Lab., Hanscom AFB, Mass.
COCHISE STUDIES 1: FLUID DYNAMICAL AND INFRARED SPECTRAL ANALYSES
G. E. Caledonia (Phys. Sci., Inc., Woburn, Mass.), B. D. Green (Phys. Sci., Inc., Woburn, Mass.), G. A. Simons (Phys. Sci., Inc., Woburn, Mass.), J. P. Kennealy, F. X. Robert, A. Corman, and F. P. DelGreco 9 Dec. 1977 71 p refs
(AF Proj. 2310)
(AD-A053218; AFGL-TR-77-0281; AEGL-ERP-619) Avail: NTIS HC A04/MF A01 CSCL 20/4

The COCHISE facility is designed to permit the study of chemiluminescent reaction kinetics under 'single' collision conditions. The effort reported here is concerned with the development of a detailed, fluid dynamical analysis to aid in the understanding of the flow field under experimental conditions. Preliminary results from the infrared chemiluminescent reaction of O2 with N(2D) atoms are analyzed, and a possible diagnostic absorption technique for the measurement of N(2D) concentrations is analyzed. Author (GRA)

N78-26397# Massachusetts Inst. of Tech., Oak Ridge, Tenn. School of Engineering Practice.
THREE-PHASE FLOW CHARACTERISTICS OF CYLINDRICAL VESSELS
F. Barreto, S. J. Anderson, B. R. Goldstein, and S. S. Moor 23 Sep. 1977 19 p refs Prepared in cooperation with ORNL
(Contract W-7405-eng-26)
(ORNL/MIT-257) Avail: NTIS HC A02/MF A01

The hydrodynamics of vertical, concurrent upflow of air and coal slurries of water and glycerol in cylindrical vessels were studied. Runs were made using an empty 1.27 cm ID x 2.5 m long column and a 2.54 cm ID x 1.6 m long column packed with 0.32 cm x 0.32 cm cylindrical pellets. The slurry flow rate varied 8 to 18 and 14 to 80 cu cm/sec for packed and unpacked vessels, respectively. The gas flow rate ranged from 10 to 300 cu cm/sec for both cases. The viscosity of the coal slurry varied from 6.5 to 26 cp by increasing its glycerine content. Residence time distribution curves were obtained by using KCl impulses and by monitoring the electrical conductivity of the slurry at the inlet and exit of the column. Using a one-dimensional dispersed plug flow model, axial dispersion coefficients, and liquid holdups were then calculated. ERA

N78-26398# Fluidyne Engineering Corp., Minneapolis, Minn.
SUPPORT TESTING AND DESIGN STUDY EVALUATION OF REGENERATIVE AIR HEATERS Progress Report, Jan. - Mar. 1977
Apr. 1977 51 p refs
(Contract EX-76-C-01-2254)
(FE-2254-5) Avail: NTIS HC A04/MF A01

Progress on the ceramic heater development program for coal-fired MHD generators is summarized. Tasks include: (1) analytical studies of full scale heaters to evaluate fullscale directly and indirectly fired regenerative air heaters suitable for use in a combined MHD-steam power plant; (2) engineering design of heater test module to design a directly-fired air heater test module suitable for construction and testing under realistic, dynamic conditions expected in an MHD power generation system; (3) design support tests to provide a basis for the analytical and design studies of (1) and (2), and to provide design, operational, and material data based on model experiments to optimize the geometry of bed components and to provide techniques to control seed and slag deposit buildup in the bed and connecting ducts; (4) liaison with materials testing and development activities to ensure maximum transfer and utilization of current materials testing and development technology. ERA

N78-26399# Sandia Labs., Albuquerque, N. Mex.
COMPUTATION OF REACTIVE TURBULENT FLOW WITHIN CYLINDRICAL COMBUSTORS
M. R. Baer Nov. 1977 23 p refs
(Contract EY-76-C-04-0789)
(SAND-77-1743) Avail: NTIS HC A02/MF A01

A computational procedure was employed to determine the axisymmetric reactive flow field within a cylindrical combustor. The full two dimensional elliptic partial differential equations were solved and a second order closure method was used for the turbulence modeling. Turbulent combustion was represented with the aid of Spalding's eddy breakup model. These flow field predictions were compared with the experimental measurements obtained by Cooper, Marek, and Strehlow and show agreement on the distribution of the species throughout the flow. The lateral momentum effect of swirl was introduced however flow prediction remains unverified. ERA

N78-26400# Sandia Labs., Albuquerque, N. Mex.
NACHOS: A FINITE ELEMENT COMPUTER PROGRAM FOR INCOMPRESSIBLE FLOW PROBLEMS. PART 2: USERS MANUAL
David K. Gartling Nov. 1977 89 p refs
(Contract EY-76-C-04-0789)
(SAND-77-1334) Avail: NTIS HC A05/MF A01

The NACHOS computer code is a general purpose computer program designed for the solution of two dimensional, incompressible fluid dynamics problems. The solution method used in NACHOS is based on the finite element method. The class of problems treated by the present version of NACHOS were those described by the two dimensional, incompressible form of the Navier-Stokes equations. An energy equation was also included in the formulation for problems in which heat transfer effects are important. Among the specific types of flow problems for which NACHOS is suitable are the following: isothermal flow problems, forced convection problems, free convection problems; mixed convection problems; and convection problems including solid body heat conduction effects. The program capabilities and organization are discussed. A detailed description of the input data necessary to access and execute the NACHOS code is presented. ERA

N78-26401# Northwestern Univ., Evanston, Ill. Dept. of Mechanical Engineering and Astronautical Sciences.
INTERNAL BOILING AND SUPERHEATING IN VAPORIZING MULTICOMPONENT DROPLETS
C. K. Law 1977 26 p refs Presented at the Fall Tech.

Meeting of the Western States Sect. of the Combust. Inst., Palo Alto, Calif., 17 Oct. 1977
(Grant EF-77-G-01-2741)
(CONF-771015-15; Paper-77-52) Avail: NTIS HC A02/MF A01

The vaporization and combustion of a miscible multicomponent droplet in a quiescent atmosphere was analyzed by assuming transient-diffusive transport within the droplet, quasi-steady diffusive-convective transport in the gas phase, and ideal solution behavior for the mixture. Results on the vaporization of a binary droplet show that due to the significant liquid-phase diffusional resistance, the vaporization process approximately consists of an initial transient regime, an intermediate, diffusion-limited, almost quasi-steady regime, and a final volatility-limited regime. It is further demonstrated that the entrapment of the volatile components within the rapidly heated droplet interior lead to the initiation of either homogeneous or heterogeneous nucleation. ERA

N78-26402# Toronto Univ. (Ontario). Dept. of Mechanical Engineering.
DESIGN METHOD FOR HEAT LOSS CALCULATION FOR IN-GROUND HEAT STORAGE TANKS
F. C. Hooper and C. R. Attwater Jul. 1977 6 p ref Presented at the Conf. on Heat Transfer in Solar Energy Systems, Atlanta, 27 Nov. - 2 Dec. 1977; sponsored by ASME
(Contract EY-76-C-02-2939)
(COO-2939-3) Avail: NTIS HC A02/MF A01

A method for calculating the temperature and heat losses for large, partially buried heat storage tanks over a seasonal heat storage cycle is presented. A lumped parameter approach was used based on three indices evaluated for particular configurations from much more detailed computations. The method appears to offer good accuracy and design convenience in predicting the transient responses of large storages associated with annual heat storage solar heating systems. ERA

N78-26403# National Aerospace Lab., Amsterdam (Netherlands). Space Flight Div.
LIQUID MOTIONS IN CONTAINERS IN ZERO GRAVITY
J. P. B. Vreeburg 28 Jul. 1977 13 p refs Presented at the 28th Intern. Astronautical Congr., Prague, Sep. 1977 Sponsored by Neth. Agency for Aerospace Programs (NIVR)
(NLR-MP-77022-U) Avail: NTIS HC A02/MF A01

The major attractiveness of space processing of materials derives from the option to establish transport phenomena in a large quantity of liquid that is either weightless or acted on solely by a rotational acceleration field. Experiments that are scheduled to be executed in the fluid physics module onboard Spacelab 1 are proposed. The main objective of these experiments is to obtain qualitative information on flow phenomena of liquids in partially filled containers for Weber numbers about one. Author (ESA)

N78-26404# National Aerospace Lab., Amsterdam (Netherlands). Space Flight Div.
CONTAINED LIQUID EXPERIMENTS ON SPACELAB 1
J. P. B. Vreeburg 1 Sep. 1977 10 p refs Presented at the Intern. Conf. on Altitude Control of Space Vehicles: Tech. and Dyn. Problems also Assoc. with the Presence of Liquids, Toulouse, 10-12 Oct. 1977 Sponsored by Neth. Agency for Aerospace Programs (NIVR)
(NLR-MP-77032-U) Avail: NTIS HC A02/MF A01

Some experiments with partially filled liquid containers proposed by the NLR are scheduled for execution on the first flight of Spacelab. The relevance of these experiments to spacecraft attitude control is noted. Various considerations that relate to the design of the experiments are discussed and clarified with reference to literature. Past and planned preparatory experiments and tests are presented. Author (ESA)

N78-26405# National Centre of Tribology, Risley (England). European Space Tribology Lab.
THERMAL CONDUCTANCE ACROSS BALL BEARINGS IN VACUUM
K. T. Stevens and M. J. Todd Paris ESA Feb. 1977 51 p refs
(Contract ESTEC-2584/75-MD)
(ESA-ESTL-25; ESA-CR(P)-1004) Avail: NTIS HC A04/MF A01

The thermal conductance for radial heat flow across ball bearings in vacuum was determined for a number of variables: bearing size, load, speed, and lubricant. Tests using bearings lubricated with a lead film showed the conductance to depend markedly on load, being linear with the calculated Hertzian contact area for the three bearing sizes. Speed, above a given value, caused a rise in conductance because, it is suggested, of a diffusivity effect. The observed conductance using liquid lubricant was essentially independent of load, except where the bearing was in a starvation condition, implying that the liquid heat path was generally dominant. Speed variation gave an initial drop in conductance to a minimum which occurred at a similar entrainment velocity for each size of bearing (indicating an effect of the ehd film) and then a rising curve parallel to that for the solid lubrication. Prolonged rotation of the bearing with different amounts of oil disclosed running-in effects on the conductance. Because of these effects and the undoubted importance of the oil's conductivity, viscosity, and surface tension, no generally valid prediction of conductance could be made; however, for the simpler case of solid lubrication, the results should be widely applicable. A summary chart is given for the present data. Author (ESA)

N78-26406# Electricity Council Research Center, Capenhurst (England).
A FLAT PLATE EVAPORATOR FOR DOMESTIC HEAT PUMPS
C. J. Blundell Aug. 1977 32 p refs
(PB-277681/3; ECRC/N-1077) Avail: NTIS HC A03/MF A01 CSCL 13A

The efficiency of a flat plate heat exchanger was compared with the conventional far coil unit, used as the evaporator of a domestic, air-to-air heat pump. Under average British winter conditions a conventional heat exchanger is shown to be more efficient, but it is shown that a practical design of flat plate evaporator would work acceptably under all conditions. GRA

N78-26272# General Motors Research Labs., Warren, Mich.
FACTORS INFLUENCING THE EVALUATION OF AN EXTERNAL HEAT TRANSFER COEFFICIENT TO BE APPLIED TO STIRLING ENGINE HEATERS
James E. Bennethum *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 2: Stirling Cycle Anal. and Eng. Design Studies Apr. 1978 8 p refs (For availability see N78-26262 17-31)
(GMR-2690-Sect-2.110) Avail: NTIS HC A14/MF A01

N78-26274# General Motors Research Labs., Warren, Mich.
DETERMINATION OF COOLER FILM COEFFICIENTS FOR THE GPU-2 STIRLING ENGINE
Stanley Nylund *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 2: Stirling Cycle Anal. and Eng. Design Studies Apr. 1978 14 p (For availability see N78-26262 17-31)
(GMR-2690-Sect-2.112) Avail: NTIS HC A14/MF A01

N78-26275# General Motors Research Labs., Warren, Mich.
AN EVALUATION OF STIRLING ENGINE COOLER ANALYSIS AND DESIGN
James E. Bennethum *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 2: Stirling Cycle Anal. and Eng. Design Studies Apr. 1978 10 p ref (For availability see N78-26262 17-31)
(GMR-2690-Sect-2.113) Avail: NTIS HC A14/MF A01

N78-26281# General Motors Research Labs., Warren, Mich.
OPTIMIZATION OF COOLER GEOMETRY FOR 10-36 STIRLING ENGINE
James E. Bennethum *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 2: Stirling Cycle Anal. and Eng. Design Studies Apr. 1978 12 p (For availability see N78-26262 17-31)
(GMR-2690-Sect-2.203) Avail: NTIS HC A14/MF A01

N78-26285# General Motors Research Labs., Warren, Mich.
STIRLING ENGINE HEATER TUBE FAILURES
John N. Johnson *In its* A Collection of Stirling Engine Reports

from General Motors' Research, 1958 to 1970. Part 3: Stirling Engine Materials and Stresses, 3.1 Stirling Engine Materials, 3.2 Stirling Engine Stresses Apr. 1978 9 p (For availability see N78-26284 17-31)
(GMR-2690-Sect-3.101) Avail: NTIS HC A10/MF A01

N78-26286# General Motors Research Labs., Warren, Mich.
STIRLING ENGINE HEATER TUBE FAILURE
John N. Johnson *In its* A Collection of Stirling Engine Reports from General Motors' Research, 1958 to 1970. Part 3: Stirling Engine Materials and Stresses, 3.1 Stirling Engine Materials, 3.2 Stirling Engine Stresses Apr. 1978 16 p (For availability see N78-26284 17-31)
(GMR-2690-Sect-3.102) Avail: NTIS HC A10/MF A01

N78-26330# General Motors Research Labs., Warren, Mich.
THERMAL ENERGY STORAGE STIRLING ENGINE POWER PLANTS 1: CALCULATED HEAT TRANSFER AND PRESSURE DROP ACROSS GROUND POWER UNIT HEATER ASSEMBLIES
John C. Steiner *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 7: Thermal Energy Storage, 7.1 Thermal Energy Storage, 7.2 List of Gen. Motors Stirling Eng. Publ. Apr. 1978 24 p refs (For availability see N78-26326 17-31)
(GMR-2690-Sect-7.104) Avail: NTIS HC A11/MF A01

N78-26336# General Motors Research Labs., Warren, Mich.
PERFORMANCE EVALUATION OF A STIRLING CYCLE HEAT PUMP
John H. Lienesch *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 7: Thermal Energy Storage and Publ. List, 7.1 Thermal Energy Storage, 7.2 List of Gen. Motors Stirling Eng. Publ. Apr. 1978 17 p (For availability see N78-26326 17-31)
(GMR-2690-Sect-7.110) Avail: NTIS HC A11/MF A01

35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources*. For related information see also *06 Aircraft Instrumentation*, and *19 Spacecraft Instrumentation*.

N78-26407*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AN ANEMOMETER FOR MEASURING VELOCITIES ON THE .25 TO 4.25 M/SEC RANGE
Thomas D. Carpini May 1978 17 p refs
(NASA-TM-78725) Avail: NTIS HC A02/MF A01 CSCL 14B

A vane type anemometer was developed as a secondary standard for the on site calibration of wind velocity sensors. The instrument outputs an electrical pulse for each interruption of a light source by an eight vane fan. The pulse rate is proportional to the fan's angular speed and linearly related to wind velocity over the range 0.25 to 4.27 m/sec. Author

N78-26408# RCA Government and Commercial Systems, Burlington, Mass. Automated Systems Div.
ZERO ORDER DIFFRACTION DISPLAY SYSTEMS Final Report, 12 Sep. 1977 - Apr. 1978
B. R. Clay and B. E. Hendrickson Mar. 1978 52 p refs
(Contract N00014-77-C-0786)
(AD-A052867) Avail: NTIS HC A04/MF A01 CSCL 17/8

This program examined the relative attributes of ZOD (Zero Order Diffraction) microimages FIH (Focused Image Holograms) holograms, and Standard Ektachrome (EK) material for application to high brightness displays. Specific comparison of brightness, resolution, contrast, and colorimetry were made using a breadboard viewing screen system allowing simultaneous side-by-side projection of the three media. Typical subject matter included aerial maps, resolution, and color bar charts. Author (GRA)

N78-26409# Battelle Pacific Northwest Labs., Richland, Wash.
HANFORD CRITICAL RADIATION DOSIMETER
R. D. Glenn and P. E. Bramson Nov. 1977 25 p refs
(Contract EY-76-C-06-1830)
(PNL-2276) Avail: NTIS HC A02/MF A01

The modified Hanford critical radiation dosimeter provides a rapid, accurate, and relatively inexpensive means of determining neutron and gamma radiation exposure dose from a radiation release of accident proportions. The neutron exposure estimation is arrived at rapidly by counting either the gold or TLD chips from the center of the paraffin moderator and performing the calculation. If the neutron spectrum has not been greatly degraded toward thermal energies, the dose value thus obtained will be accurate to within + or - 15%. Degradation depends on the amount and type of shielding material through which the neutrons pass before reaching the dosimeter. Shielding materials with a high hydrogen content, such as concrete, paraffin, and water, are usually used when neutron shielding is desired. ERA

N78-26410# Idaho National Engineering Lab., Idaho Falls.
EVALUATION OF A NOVEL VENTURI COLLECTION DEVICE
T. E. Carleson and E. S. Grimmett Dec. 1977 44 p refs
(Contract EY-76-C-07-1540)
(ICP-1134) Avail: NTIS HC A03/MF A01

Laboratory scale tests were conducted to compare a venturi scrubber design with a conventional design. Operation of the small unit (1/4-inch throat diameter) at throat gas velocities of 100 to 400 ft/sec and liquid rates of 5 to 15 gal/1,000 cubic feet of gas yielded collection efficiencies of from 4 to 87 percent for latex hydrosols of 0.5 and 0.8 microns diameter. Calcine dust generated by fluidizing alumina calcine product in a pilot 10-cm dia fluidized bed was found to have a mass mean diameter of 2 microns with a standard deviation of 2.5. Collection of the calcine dust by the small scale novel device indicates mass removal efficiencies of around 98 percent at the pressure drop encountered in the full-scale calciner off-gas system. Based on the results of the laboratory scale tests, pilot scale evaluation of the novel device is recommended. ERA

N78-26411# Brookhaven National Lab., Upton, N. Y.
SEPARATED FUNCTION FOCUSING MONOCHROMATOR SYSTEM FOR SYNCHROTRON RADIATION
J. B. Hastings, B. M. Kincaid, and P. Eisenberger 1977 18 p refs Presented at the Conf. on Synchrotron Radiation Instrumentation, Orsay, France, 15 Sep. 1977 Prepared in cooperation with Bell Telephone Labs., Murray Hill, N. J.
(Contract EY-76-C-02-0016)
(BNL-23353; Conf-770988-1) Avail: NTIS HC A02/MF A01

The design and performance of general purpose focusing monochromator system is presented. Such a system is ideally suited to collect, focus, and monochromate the highly directional, broad band synchrotron radiation. ERA

N78-26412# Brookhaven National Lab., Upton, N. Y.
CHARGED PARTICLE DETECTOR SYSTEM FOR ISABELLE SPECTROMETERS
E. D. Platner 1977 11 p ref Presented at the ISABELLE Workshop, Upton, N. Y., 18 Jul. 1977
(Contract EY-76-C-02-0016)
(BNL-23529; Conf-770753-25) Avail: NTIS HC A02/MF A01

A detector system combining the good time resolution and low dead time of PWC's and the good space resolution of drift chambers is proposed for use in ISABELLE spectrometers. Central to this detector is the development of two integrated electronic circuit systems. The detectors are described with special emphasis on the electronic systems. The detector system proposed will be capable of handling particle flux rates typical of conventional PWC's yet providing a spacial resolution of 100 microns. Another advantage is that a large area detector of such performance will become technically feasible as well as economically viable. The detector is a conventional narrow anode spacing drift chamber with field wires. A digital delay-time encoder circuit is used for readout. ERA

N78-26413# Cornell Univ., Ithaca, N. Y. Materials Science Center.

NOVEL FARADAY CUP FOR THE SIMULTANEOUS OBSERVATION AND MEASUREMENT OF ION-BEAM CURRENTS

Ching-Yeu Wei and David N. Seidman Jul. 1977 15 p refs Sponsored in part by NSF

(Contract EY-76-S-02-3158)

(COO-3158-55; MSC-2864) Avail: NTIS HC A02/MF A01

The Faraday cup is constructed around a Galileo channel electron multiplier array (CEMA) which serves as the basis of an internal image intensification system (a gain of greater than 10,000 for the observation of the ion beam; the CEMA also acts as a collector for the ion cured by a Keithley 602 electrometer. The ion current is integrated by a simple and inexpensive dosimeter; the electronic circuit for the dosimeter is described. The application of the Faraday cup to the observation and measurement of a 30 keV Ar(+) ion beam is presented as an illustrative example. This Faraday cup was also employed to observe and measure 30 keV Cr(+), Mo(+) or W(+) and 18 keV Au(+) ion beam employed for the in-situ irradiation of field-ion microscope specimens. ERA

N78-26414# Technological Lab. RVO-TNO, Rijswijk (Netherlands).

INVESTIGATION OF BLAST RESISTANT MATERIAL. DESCRIPTION OF A SCHLIEREN SYSTEM AND OF A DIFFERENTIAL INTERFEROMETER [ONDERZOEK BLASTBESTENDIGHEID MATERIEEL. BESCHRIJVING VAN SCHLIERENSYSTEEM EN DIFFERENTIAALINTERFEROMETER]

P. J. Vrugt 18 Feb. 1977 46 p refs In DUTCH; ENGLISH summary

(Contracts A75/KM/106; A75/KL/091)

(TL-1977-9; TDCK-69570) Avail: NTIS HC A03/MF A01

In order to study blast interaction on models, several density difference measurement techniques were surveyed. The shadow and schlieren methods as well as differential interferometry are dealt with extensively. It is concluded that interference methods are most suitable, but a schlieren apparatus transformed into a differential interferometer also provides a good possibility. Some photographic evidence of experimental tests are shown in the appendix. ESA

N78-26415# Technische Physische Dienst TNO-TH, Delft (Netherlands). Afd. Optiek.

INVESTIGATION ON PHOTOTHERMOPLASTS FOR INFORMATION STORAGE [ONDERZOEK AAN FOTOTHERMOPLASTEN VOOR INFORMATIE-OPSLAG]

H. J. Raterink, W. Werner, and A. Handojo 1 Sep. 1977 71 p refs In DUTCH

(Contract A76/K/073)

(TPD-1977-0-2; TDCK-69760) Avail: NTIS HC A04/MF A01

The properties of a photothermoplastic recording system for the production of holograms are discussed. Theoretical considerations of the functioning of photothermoplastic recording, various recording techniques, and the factors influencing the quality attainable are given. Measurements on a commercially available holographic thermoplastic recording system (Rottenkolber Holo-System) are reported. The influence of various recording parameters was investigated. Conclusions regarding possible improvements to the system are given. ESA

N78-26416# Deutsches Geodaetisches Forschungsinstitut, Munich (West Germany).

PARTIAL CALIBRATION OF A PHOTOGRAMMETRIC SYSTEM WITH VARIABLE PASS POINT SET-UP AND WITH DIFFERENT DETERMINISTIC FORMULATIONS Ph.D. Thesis - Bonn Univ. [TEILKALIBRIERUNG EINES PHOTOGRAMMETRISCHEN SYSTEMS MIT VARIABLER PASSPUNKTANORDNUNG UND UNTERSCHIEDLICHEN DETERMINISTISCHEN ANSAETZEN]

Landolf Mauelshagen Bayerische Akad. der Wiss. 1977 121 p refs In GERMAN

(Ser-C/Diss-236; ISBN-3-7696-9290-X) Avail: NTIS HC A06/MF A01

Investigations were carried out under operational conditions. Topics include the analytical conception of beam block adjustment, notably the mathematical model; the construction of the improvement equations; structure and solving of the normal equations; and the refined mathematical model. The Bonn beam adjustment program, ROBUE, is presented and test field flight tests are discussed. ESA

N78-26417# National Bureau of Standards, Washington, D. C.

FROM SUNDIALS TO ATOMIC CLOCKS: UNDERSTANDING TIME AND FREQUENCY Final Report

James Jespersen and Jane Fitz-Randolph Dec. 1977 178 p refs

(PB-277747/2; NBS-Mono-155; LC-77-600056) Avail: NTIS HC A09/MF A01 CSCL 14B

A historical review of clocks and watches leads into a discussion of today's most sophisticated time piece, the atomic clock. The need for highly accurate atomic time to a millonth of a second or better, is described as it relates to a number of modern-day activities and systems such as advanced electronic communication systems, satellite navigation systems, and precise scientific measurements in radio astronomy and in tests of the theory of relativity. Discussion of the relationship of time to mathematics, physics, astronomy, and automation is included. GRA

N78-26418# Environmental Sciences Research Lab., Research Triangle Park, N.C. Emission Measurement and Characterization Div.

EVALUATION OF A PROPORTIONAL SAMPLER FOR AUTOMOTIVE EXHAUST EMISSIONS

Peter A. Gabele Dec. 1977 29 p refs

(PB-278186/2; EPA-600/2-77-236) Avail: NTIS HC A03/MF A01 CSCL 14B

A test program was conducted to evaluate a proportional sampler for use in automotive exhaust gas emissions research. Automobile emissions test results obtained using the proportional sampler were compared with results obtained using the conventional constant volume sampler. Measurements obtained using the proportional sampler for hydrocarbons, carbon monoxide, nitrogen oxides, and carbon dioxide are within 19, 46, 20, and 14 percent, respectively, of measurements obtained using the constant volume sampler. Such differences render the proportional sampler unacceptable as a quantitative research tool. Inability of the exhaust gas flow meter to accurately measure pulsating exhaust flow is cited as the principal cause of error in the proportional sampler. GRA

N78-26419# Coordinating Research Council, Inc., New York. Air Pollution Research Advisory Committee.

A LABORATORY COMPARISON OF IN-LINE AND END-OF-LINE FULL-FLOW, DIESEL SMOKE OPACITY METERS

Aug. 1977 66 p refs

(PB-278076/5; CRC-495; CRC-APRAC-CAPI-1-64) Avail: NTIS HC A04/MF A01 CSCL 14B

A cooperative round robin type program to compare the response characteristics of in-line (NL) and EPA end-of-line (EOL) diesel smoke opacity meters is described. Test results indicated the INL and EOL meters correlated well, agreeing approximately 75% of the time. Best correlation was obtained by using a modified Beer-Lambert expression, i.e., correcting the absorption coefficient for meter emitted light wavelength. The study recommends that future tests consider including detailed optical response characteristics. Further investigation into the use of neutral density filters as calibration standards as well as research to ascertain whether or not the exhaust gas temperature has any effect on smoke correlation are also recommended. GRA

N78-26420# Bureau of Radiological Health, Rockville, Md. Div. of Radioactive Materials and Nuclear Medicine.

MEASUREMENTS OF THE PERFORMANCE PARAMETERS OF GAMMA CAMERAS, PART 1 Final Report

Gerald J. Hine, Peter Paras, and Charles P. Warr Dec. 1977 53 p refs

(PB-277482/6; FDA/BRH-78/30-Pt-1; FDA-78-8049) Avail: NTIS HC A04/MF A01 CSCL 06L

The various parameters that affect gamma camera performance are identified and the results of field tests conducted on 20 camera models are presented. Since uniform test methods were employed, the data can be used to compare the imaging capabilities of models from different manufacturers. The initial investigation was limited to Anger-type gamma (scintillation)

cameras with various low-energy parallel-hole collimators. All measurements were carried out with gamma rays in the low-energy range of 140 keV. Among the performance parameters measured were spatial resolution, absolute plane sensitivity, and temporal resolution. GRA

36 LASERS AND MASERS

Includes parametric amplifiers.

N78-26421 Minnesota Univ., Minneapolis.
A STUDY OF ISOTOPE SHIFTS AND HYPERFINE SPLITTING OF SOME RARE-EARTH ELEMENTS USING A TUNABLE DYE LASER Ph.D. Thesis
David Lee Clark 1977 285 p
Avail: Univ. Microfilms Order No. 7809642

The hyperfine splitting and isotope shifts of all the naturally occurring isotopes of neodymium, dysprosium, erbium and ytterbium are reported. Ten transitions were measured for even isotopes of neodymium. The hyperfine splitting for the two odd isotopes of neodymium was measured for only one transition. Both isotope shifts, and hyperfine structure were measured for all transitions for all other elements. Five transitions were measured for samarium, five for dysprosium, four for erbium, and one for ytterbium. Magnetic dipole and electric quadrupole coupling constants were extracted for the excited states. Hyperfine anomalies were observed in dysprosium and ytterbium. The isotope shifts are analysed to obtain values for changes in radial moments of the nuclear charge distribution. Dissert. Abstr.

N78-26422 Stanford Univ., Calif.
THE OPTICALLY-PUMPED MERCURY VAPOR LASER Ph.D. Thesis
Neil Conrad Holmes 1978 79 p
Avail: Univ. Microfilms Order No. 78-08798

Both the theoretical and practical aspects of the optically pumped cw mercury vapor laser at 546.1 mm was explored. A rate-equation analysis was used to develop a quantitative model describing the nitrogen pressure dependence of laser power output and unsaturated gain. Measurements were also made as the pumping rates, bore diameter, and mercury density were varied. A qualitative treatment of the effects of high intensity pumping and radiation trapping is given. The nitrogen quenching rate across the laser transition was found to be 700,000/sec Torr, and the pressure broadening of the green laser line was inferred to be 26.4 MHz/Torr. A detailed description of the experimental apparatus is given. Dissert. Abstr.

N78-26423 Cornell Univ., Ithaca, N. Y.
CO2 LASER ABSORPTION AND SATURATION STUDIES OF MOLECULAR IMPURITIES IN ALKALI HALIDES Ph.D. Thesis
Andrew Roman Chraplyvy 1977 200 p
Avail: Univ. Microfilms Order No. 7809464

Optical properties of pure and doped alkali halide crystal between 9 micron and 11 micron were using CO2 lasers and Michelson interferometers. The extrinsic absorption due to residual impurities in purified alkali halides was used to categorize the optical quality of the crystals. The absorption in doped crystals was studied both interferometrically from which the internal vibrational modes of the molecular impurities were identified and by means of saturation spectroscopy from which excited-state lifetimes of molecular vibrations were determined. Dissert. Abstr.

N78-26424 Colorado State Univ., Fort Collins.
NEW SPUTTERED METAL VAPOR LASER SYSTEMS Ph.D. Thesis
John Robert McNeil 1977 153 p
Avail: Univ. Microfilms Order No. 7807433

Several rare gas, metal vapor systems were investigated, and cw laser oscillation was observed at a number of transitions between 8400 A and 2250 A in the singly ionized spectrum of Cu, Ag, and Au. The primary population mechanism of the upper level of the majority of the laser transitions is believed to be charge transfer collisions between rare gas ions and neutral metal atoms. The laser transitions were inverted in a hollow cathode discharge, and the metal vapor necessary for laser action was produced by discharge sputtering of the cathode. Spontaneous intensity, absorption, and transition lineshape measurements were made on several species in the discharge. A simple rate equation model of the discharge was developed. Dissert. Abstr.

N78-26425*# SRI International Corp., Menlo Park, Calif.
EVALUATION OF A NEAR-INFRARED PHOTOMULTIPLIER Final Report
William E. Evans Mar. 1978 57 p refs
(Contract NAS1-15114; SRI Proj. 6919)
(NASA-CR-145380) Avail: NTIS HC A04/MF A01 CSCL 20E

A high performance near infrared sensitive photomultiplier tube was procured and evaluated with emphasis on those characteristics affecting its use over the very large amplitude range of signals encountered by an airborne lidar intended for mapping the distribution of stratospheric aerosols. A cathode quantum efficiency of 4.3 percent at 1.06 micrometer wavelength and a background count of less than 10,000 per second were realized. It is recommended that the tube be stored and operated at a temperature near -20 C, or cooler. Performance was found acceptable for the application in both pulse counting and analog modes, but careful design, probably including dynamic gain control, will be required to effectively utilize both modes on the same lidar shot. B.B.

N78-26426*# Mitre Corp., McLean, Va. Metrek Div.
STUDY OF THE EFFECT OF SCATTERING FROM TURBID WATER ON THE POLARIZATION OF A LASER BEAM
Robert G. Henderson and Ali H. Hovanlou Mar. 1978 138 p refs
(Contract F19628-77-C-0001)
(NASA-CR-145327; MTR-7666) Avail: NTIS HC A07/MF A01 CSCL 20E

A Monte Carlo simulation method was used to determine the effect of scattering from turbid water on the polarization of a backscattered beam of laser light. The relationship between the polarization and the type and amount of suspended particulates in the water was investigated. G.G.

N78-26427# Westinghouse Electric Corp., Pittsburgh, Pa. Research and Development Center.
COPPER HALIDE LASER RESEARCH Final Report
C. S. Liu, D. W. Feldman, J. L. Pack, and L. A. Weaver 31 Dec. 1977 92 p refs
(Contract N00014-74-C-0445)
(AD-A053237) Avail: NTIS HC A05/MF A01 CSCL 20/5

This report describes results of experimental studies of continuously-pulsed copper halide laser systems. Optical absorption and fluorescence measurements in the copper bromide discharge have produced detailed information about the laser kinetics in such systems. In particular, the absorption measurements led to determinations of the copper ground state and excited state densities as a function of time and position during a series of electrical pulses. In a longitudinal discharge configuration, radial pumping effects were found to produce appreciable depletion of copper atoms from the core of the discharge region. The effects of this phenomenon on laser performance are discussed and recommendations are made for future development efforts in copper halide lasers. Author (GRA)

N78-26428# Los Alamos Scientific Lab., N. Mex.
LASER SYNTHETIC CHEMISTRY
Kevin M. Leary and John H. Clark 1977 11 p refs Presented at the Electro Optics/Laser 77 Conf., Anaheim, Calif., 25-27 Oct. 1977
(Contract W-7405-eng-36)
(LA-UR-2790; Conf-771040-10) Avail: NTIS HC A02/MF A01

By choosing the laser, wavelength, and starting materials, virtually any free radical species can be produced, leading to new compounds. SF5NF2 was prepared in this way. Laser-driven catalysis can be used to increase the efficiency of the photons. It is shown that in the photolytic isomerization of cis-2-butene to trans-2-butene using carbonyl solfide (OCS), the catalytic species is free S(P-3) atoms. Author (ERA)

N78-26429# Bendix Corp., Kansas City, Mo.
UNIVERSAL MONITOR FOR CO2 LASERS
Leonard D. Wonnell 1977 14 p refs Presented at the Electro-Opt. Systems Design Conf., Anaheim, Calif., 25-27 Oct. 1977
(Contract EY-76-C-04-0613)
(BDX-613-1907; Conf-771040-9) Avail: NTIS HC A02/MF A01

A system was developed for characterizing the profile, average power, and pulse shape of a CO2 laser beam. The design includes an integrating sphere, a pyroelectric detector, interchangeable chopper-wheel attenuators, and relatively simple circuitry that can be expanded to accommodate inputs in excess of 10 kW. The profile of the entire beam is rapidly scanned and displayed in a three-dimensional oscilloscope pattern. Average power was determined by a synchronous rectifier and was read with a digital voltmeter. The pulse shape was monitored by the use of conventional oscilloscope techniques. This system greatly simplifies the on-site calibration of CO2 lasers in factory areas. ERA

N78-26430# California Univ., Livermore. Lawrence Livermore Lab.
CONCEPTUAL DESIGN OF A LASER FUSION POWER PLANT
J. A. Maniscalco, W. R. Meier, and M. J. Monsler 14 Jul. 1977 32 p refs Presented at 20th Ann. AICHE Meeting, New York, 13 Nov. 1977
(Contract W-7405-eng-48)
(UCRL-79652; Conf-771102-9) Avail: NTIS HC A03/MF A01

A conceptual design of a laser fusion power plant is extensively discussed. Recent advances in high gain targets are exploited in the design. A smaller blanket structure is made possible by use of a thick falling region of liquid lithium for a first wall. Major design features of the plant, reactor, and laser systems are described. A parametric analysis of performance and cost vs. design parameters is presented to show feasible design points. ERA

N78-26431# California Univ., Livermore. Lawrence Livermore Lab.
A 2660 A HOLOGRAPHIC INTERFEROMETRY OF LASER PRODUCED PLASMAS FROM TILTED DISK TARGETS
J. M. Auerbach, D. T. Attwood, P. H. Y. Lee, and D. W. Sweeney 21 Oct. 1977 23 p refs Presented at Ann. Am. Physical Soc. Meeting, Atlanta, 7 Nov. 1977
(Contract W-7405-eng-48)
(UCRL-79775; Conf-771136-20) Avail: NTIS HC A02/MF A01

Using double exposure holographic interferometry, an investigation was made of the Nd laser produced plasmas surrounding disk targets irradiated at different angles of incidence. Measurements have produced a detailed description of the plasma profile necessary for realistic simulations of resonance absorption. A 2660A 15 psec probe pulse is produced by frequency quadrupling a fraction of the main Nd laser pulse from the Janus laser. F/1 and f/10 lenses were utilized to irradiate the targets with intensities ranging from 10 to the 13th power w/sq cm to 10 to the 16th power w/sq cm. Measurements have produced the shape of the electron density profile near critical, the direction of the plasma blowoff, and revealed transverse rippling of the isodensity surfaces. ERA

N78-26432# Aerospace Corp., El Segundo, Calif. Chemistry and Physics Lab.
ISOTOPIC HCl TRANSFER LASER
C. C. Badcock, W. C. Hwang, J. F. Kalsch, and R. F. Kamada 15 Dec. 1977 15 p refs
(Contract EY-76-C-03-1017)
(ATR-78(8127)-1) Avail: NTIS HC A02/MF A01

An HCl laser which uses isotopic V-V energy transfer collisions as a pumping mechanism was demonstrated. This multiline laser, which utilized an intracavity cold gas isotope filter, increased the energy from the P1 lines of H37Cl while decreasing the energies of the P1 and P2 lines of H35Cl. Previously unreported lines, including emission from R branch transitions, were also observed from single-line HCl and HBr lasers. ERA

N78-26433# Lincoln Lab., Mass. Inst. of Tech., Lexington.
EFFICIENT HIGH ENERGY INFRARED THIRD HARMONIC GENERATION IN GASES AND LIQUIDS FOR LASER FUSION APPLICATIONS Quarterly Progress Report, 1 Jun. - 31 Aug. 1977
H. Kildal and S. R. J. Brueck Sep. 1977 7 p
(Contract ES-77-S-02-4251)
(COO-4251-2) Avail: NTIS HC A02/MF A01

Experimental work was concentrated on verifying the theoretical analysis of the four-wave mixing process in liquid CO using CO2 lasers. It was demonstrated that efficient sum frequency generation can be obtained using several different combinations of CO2 pump frequencies. Both the absolute magnitude of the nonlinear susceptibility and the polarization dependence were investigated. Difference frequency generation processes were also demonstrated. The search for other media suitable for tripling CO2 laser radiation with experimental Raman measurements on CH4 and CD4 liquid and a theoretical analysis of SF6 dissolved in host liquids were contained. Tripling of HF laser radiation in HF gas was also analyzed. ERA

N78-26434# Avco-Everett Research Lab., Everett, Mass.
METAL VAPOR EXCIMER LASER Quarterly Progress Report, 1 May - 31 Jul. 1977
M. A. Kovacs and J. H. Jacob Oct. 1977 27 p refs
(Contract ES-77-C-02-4275)
(COO-4275-1) Avail: NTIS HC A03/MF A01

The CdHg excimer program will attempt to determine the existence of optical gain in a discharge pumped high temperature medium. This first quarterly contract period primarily involves detailed design of the experimental apparatus capable of producing high temperature metal vapor. The report begins with the general considerations which went into designing the experiment and follows with descriptions and schematics of the experiment as presently conceived. ERA

N78-26435# California Univ., Davis. Dept. of Mechanical Engineering.
RESEARCH ON THE WETTED FIRST WALL CONCEPT FOR FUTURE LASER FUSION REACTORS Final Report, 1 Feb. 1976 - 31 Aug. 1977
Myron A. Hoffman Sep. 1977 62 p refs
(Contract W-7405-eng-48)
(UCRL-13677-3; FR-2) Avail: NTIS HC A04/MF A01

The possible application of thin, falling liquid lithium films to protect the inner walls of future laser fusion reactors is discussed. It was proposed that the relatively smooth initial region of a falling liquid film can provide the nearly uniform liquid thickness on the order of a few hundred micrometers required to prevent radiation and plasma ions from the fusion micro-explosion from seriously damaging the solid first wall. In order to extend the existing results on liquid films to the higher surface tension numbers characteristic of alkali metals, experiments using hot water on a vertical plate were run primarily in the wavy laminar flow regime. Results show that very low minimum flow rates can fully wet the surface provided that the surface is carefully cleaned and preconditioned. It is also shown that both the wave inception distance and the equilibrium wave amplitude decrease as the surface tension number increases for a given flow Reynolds number. ERA

N78-26436# California Univ., Livermore. Lawrence Livermore Lab.
SHIVA Nd: GLASS DISK-AMPLIFIER-ASSEMBLY FACILITY AND SPECIAL PURPOSE FIXTURES
W. A. Jones, H. G. Patton, I. F. Stowers, and D. E. Wentworth Sep. 1977 9 p
(Contract W-7405-eng-48)
(UCID-17703) Avail: NTIS HC A02/MF A01

The facility built to assemble and maintain the laser amplifiers in the SHIVA Laser System is described. The facility is a Class-100 clean room which includes a high pressure solvent spray box, optical inspection equipment, and several unique amplifier-assembly fixtures. ERA

N78-26437# California Univ., Livermore. Lawrence Livermore Lab.
PONDEROMOTIVE FORCE IN A HYDRODYNAMIC SIMULATION CODE

Judith Harte and George Zimmerman 6 Oct. 1977 25 p refs Presented at the 19th Meeting of the Am. Phys. Soc./Div. of Plasma Physics, Atlanta, 6-11 Nov. 1977
(Contract W-7405-eng-48)
(UCRL-79860; Conf-771136-7) Avail: NTIS HC A02/MF A01

For laser intensities approximately 3 x 10 to the 15th power/sq cm the radiation pressure of 1.06 micron light is equivalent to the pressure of a 1 keV hydrogen plasma at the critical density. Experiments indicate and particle simulations predict significant profile modification by the ponderomotive force. An algorithm to calculate the ponderomotive force in the hydrodynamic approximation is described, as well as its implementation in the LASNEX code. The algorithm was derived by demanding that momentum be conserved and by using the WKB solution for the fields. In this approximation the algorithm is identical with the corresponding analytic expression, i.e., the divergence of the radiation pressure tensor including absorption. The oscillatory character of the force is not present. Sample calculations show steady state profiles with density steps at the critical surface which are consistent with predicted values. ERA

N78-26438# California Univ., Livermore. Lawrence Livermore Lab.
RARE EARTH VAPOR LASER STUDIES
W. F. Krupke 13 Sep. 1977 8 p refs Presented at 13th Rare Earth Res. Conf., Olgebay Park, West Va., 16 Oct. 1977
(Contract W-7405-eng-48)
(UCRL-79364; Conf-771039-9) Avail: NTIS HC A02/MF A01

The fluorescence decay rates of vapor phase neodymium aluminum chloride complex (Nd-Al-Cl) and neodymium-thd-chelate were measured as functions of temperature, partial pressure and optical excitation intensity. Fluorescence quenching due to both ground and excited state collisions was observed in Nd-Al-Cl vapor. In contrast, quenching in the Nd-thd vapor was found to be dominated by multiquantum excitation of molecular vibrations. The fluorescence kinetics of Tb-Al-Cl vapor were also examined under conditions of intense excitation of terbium 5d levels by a KrF laser source. Both prompt and delayed fluorescence of the 4f8(5D4) metastable level were observed together with evidence of excited state collisional quenching. In laser amplifier experiments, a transient population inversion was produced in Nd-Al-Cl vapor with a small signal gain coefficient greater than or equal to 0.25%/cm and a stored energy density approximately equal to 35 J/liter. ERA

N78-26439# Technische Universitaet, Munich (West Germany).
REMOTE SENSING USING TUNABLE LASERS
K. W. Rothe and H. Walther 1977 15 p refs
(AED-Conf-77-165-002) Avail: NTIS (US Sales Only) HC A02/MF A01; DoE Depository Libraries

Summarizing the present situation of pollution monitoring by means of LIDAR it can be said that it is proven that the differential absorption method is the most sensitive technique known at present. TEA lasers are suitable light sources for a general application in the infra-red spectral region. The sensitivity which can be expected with those lasers allows to probe the atmosphere in the vicinity of chemical factories or other pollution sources over distances of about 3 km. Further improvements are possible e.g. by the use of heterodyne detection or by the use of frequency up-conversion for signal detection. A considerable step forward can still be expected when continuously tunable lasers as e.g. parametric oscillators of sufficient output are used for the measurements. ERA

N78-26440# Technische Universitaet, Munich (West Germany). Inst. fuer Astronomische und Physikalische Geodaesie.
ON THE ACCURACY OF COMPUTED TOPOCENTRIC DISTANCES OF LUNAR RETROREFLECTORS IN VIEW OF AN APPLICATION OF LUNAR LASER RANGING TECHNIQUE TO THE DETERMINATION OF THE EARTH'S ROTATION
Barbara Kolaczek (Warsaw Tech. Univ.) Jan. 1977 21 p refs Sponsored by Alexander-von-Humboldt Found.
(TUM-Mitt-144) Avail: NTIS HC A02/MF A01

Influences of known values of errors of different parameters defining the lunar physical libration, the moon's positions, and positions of lunar retroflectors, as well as of terrestrial stations on measured topocentric distances of lunar retroflectors, are discussed in view of an application of a lunar laser ranging technique to the earth's rotation study. Author (ESA)

N78-26847*# Illinois Univ., Urbana-Champaign. Nuclear Engineering Program and Gaseous Electronics Lab.
THE PUMPING MECHANISM FOR THE NEON-NITROGEN NUCLEAR EXCITED LASER
G. W. Cooper, J. T. Verdeyen, W. E. Wells, and G. H. Miley *In* Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 91-101 refs (For availability see N78-26837 17-70)
Avail: NTIS HC A13/MF A01 CSCL 20E

N78-26848*# Illinois Univ., Urbana. Nuclear Engineering Program.
RECENT NUCLEAR PUMPED LASER RESULTS
G. H. Miley, W. E. Wells, M. A. Akerman, and J. H. Anderson *In* Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 102-108 refs Sponsored in part by DOE (For availability see N78-26837 17-70)
Avail: NTIS HC A13/MF A01 CSCL 20E

N78-26849*# Stanford Research Inst., Menlo Park, Calif. Molecular Physics Center.
NUCLEAR FISSION FRAGMENT EXCITATION OF ELECTRONIC TRANSITION LASER MEDIA
D. C. Lorents, M. V. McCusker, and C. K. Rhodes *In* Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 109-114 refs (For availability see N78-26837 17-70)
Avail: NTIS HC A13/MF A01 CSCL 20E

N78-26850*# Sandia Labs., Albuquerque, N. Mex.
DEVELOPMENT OF A HIGHER POWER FISSION-FRAGMENT-EXCITED CO LASER
D. A. McArthur *In* Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 115-122 refs Sponsored in part by DOE (For availability see N78-26837 17-70)
Avail: NTIS HC A13/MF A01 CSCL 20E

N78-26864*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
BROADBAND PHOTOEXCITATION OF LASERS
R. V. Hess, A. Javan (Mass. Inst. of Tech., Cambridge), and P. Brockman *In* Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 239-243 refs (For availability see N78-26837 17-70)
Avail: NTIS HC A13/MF A01 CSCL 20E

N78-26870*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CONSIDERATIONS TO ACHIEVE DIRECTIONALITY FOR GAMMA RAY LASERS
S. Jha (Cincinnati Univ.) and J. Blue *In* Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 275-279 refs (For availability see N78-26837 17-70)
(Grant NsG-3091)
Avail: NTIS HC A13/MF A01 CSCL 20E

37 MECHANICAL ENGINEERING

Includes auxiliary systems (non-power); machine elements and processes; and mechanical equipment.

N78-26441 Princeton Univ., N. J.
THE HEATING OF PNEUMATIC TIRES AND DISSIPATION IN A VOIGT VISCOELASTIC SHELL WITH INTERNAL PRESSURE Ph.D. Thesis
Douglas R. Raichle 1978 92 p
Avail: Univ. Microfilms Order No. 7807492

The heating of a pneumatic tire in service is modelled by

considering the temperature rise of a Kelvin-Voigt viscoelastic cylindrical shell of infinite extent bonded to rims and subjected to an internal pressure, the loading being either a single stationary concentrated harmonic load or an infinite set of concentrated loads moving along the crown in an axial direction. Temperature rise is calculated assuming no heat path through the contained air, rims at ambient temperature, and a discontinuous film coefficient at the outside surface due to the combined effects of cooling by road speed air and by conductive transfer of heat to the road surface. Numerical results are given for both time-averaged dissipation fields and for temperature rise in the case of the moving loads. Good agreement with experimental surface temperature profiles is obtained, including the well-known shoulder peak. Theory and experiment agree well for a variety of inflation pressures at moderate loadings. Dissert. Abstr.

N78-26442*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

DESIGN APPROACHES TO MORE ENERGY EFFICIENT ENGINES

Neal T. Saunders, Raymond S. Colladay, and Lawrence E. Macioce Jul. 1978 13 p refs Presented at the 14th Propulsion Conf., Las Vegas, Nev., 25-27 Jul. 1978; cosponsored by AIAA and SAE

(NASA-TM-78893) Avail: NTIS HC A02/MF A01 CSCL 10B

The status of NASA's Energy Efficient Engine Project, a comparative government-industry effort aimed at advancing the technology base for the next generation of large turbofan engines for civil aircraft transports is summarized. Results of recently completed studies are reviewed. These studies involved selection of engine cycles and configurations that offer potential for at least 12% lower fuel consumption than current engines and also are economically attractive and environmentally acceptable. Emphasis is on the advancements required in component technologies and systems design concepts to permit future development of these more energy efficient engines. G.Y.

N78-26443*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

ADDITIONAL ASPECTS OF ELASTOHYDRODYNAMIC LUBRICATION

Bernard J. Hamrock Jun. 1978 15 p refs Presented at the Intern. Conf. Fundamentals of Tribology, Cambridge, Mass., 19-22 Jun. 1978; sponsored by ARO, DARPA, MIT, and ONR (NASA-TM-78898; E-9634) Avail: NTIS HC A02/MF A01 CSCL 11H

An up-to-date review of the varying aspects of elastohydrodynamic lubrication is presented.. Some recent work on elastohydrodynamic lubrication of materials of low elastic modulus as well as on hydrodynamic lubrication is included. Both these topics are applicable for contacts with any ellipticity parameter (ranging from a circular contact to a line contact). G.G.

N78-26444*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

PROPOSED DESIGN PROCEDURE FOR TRANSMISSION SHAFTING UNDER FATIGUE LOADING

Stuart H. Loewenthal 1978 10 p refs To be presented at the 5th Ann. Meeting of the Natl. Conf. on Power Transmission, Philadelphia, 7-9 Nov. 1978; sponsored by the Ill. Inst. of Technol.

(NASA-TM-78927; E-9667) Avail: NTIS HC A02/MF A01 CSCL 13I

A new standard for the design of transmission shafting is reported. Computed was the diameter of rotating solid steel shafts under combined cyclic bending and steady torsion is presented. The formula is based on an elliptical variation of endurance strength with torque exhibited by combined stress fatigue data. Fatigue factors are cited to correct specimen bending endurance strength data for use in the shaft formula. A design example illustrates how the method is to be applied. G.G.

N78-26445*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

SOME LOAD LIMITS AND SELF-LUBRICATING PROPERTIES OF PLAIN SPHERICAL BEARINGS WITH MOLDED GRAPHITE FIBER REINFORCED POLYIMIDE LINERS TO 320 C

Harold E. Sliney 1978 13 p refs To be presented at the Joint Lubrication Conf., Minneapolis, 24-26 Oct. 1978; cosponsored by the Am. Soc. of Lubrication Engr. and the Am. Soc. of Mech. Engr.

(NASA-TM-78935; E-9678) Avail: NTIS HC A02/MF A01 CSCL 13I

Plain spherical bearings with molded liners of self-lubricating graphite fiber-polyimide composite were developed and their dynamic load capacities were determined. Liners were prepared by transfer molding a prepolymer resin-fiber mix into the space between the ball and outer race, the completing polymerization under heat and pressure. Bearing dynamic load capacities were in excess of 140 MPa (20,000 psi) from room temperature to 260 C and about 70 MPa (10,000 psi) at 320 C. Friction coefficients were about 0.20 at room temperatures and light loads and tended to decrease with increasing temperatures and loads to about 0.15. Thermal expansion of the liner at uniform bearing temperatures of 200 C or higher produced a bearing preload which could be alleviated by providing an initial internal diametral clearance of 0.05 to 0.10 mm. Author

N78-26446*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

FILTRATION EFFECTS ON BALL BEARING LIFE AND CONDITION IN A CONTAMINATED LUBRICANT

Stuart H. Loewenthal and Donald W. Moyer (Tribon Mfg. Co., Cleveland) Oct. 1978 26 p refs Proposed for presentation at the Joint Lubrication Conf., Minneapolis, 24-26 Oct. 1978; sponsored by the Am. Soc. of Mech. Engr. and the Am. Soc. of Lubrication Engr.

(NASA-TM-78907; E-9418) Avail: NTIS HC A03/MF A01 CSCL 13I

Ball bearings were fatigue tested with a noncontaminated lubricant and with a contaminated lubricant under four levels of filtration. The test filters had absolute particle removal ratings of 3, 30, 49, and 105 microns. Aircraft turbine engine contaminants were injected into the filter's supply line at a constant rate of 125 milligrams per bearing hour. Bearing life and running track condition generally improved with finer filtration. The experimental lives of 3 and 30 micron filter bearings were statistically equivalent, approaching those obtained with the noncontaminated lubricant bearings. Compared to these bearings, the lives of the 49 micron bearings were statistically lower. The 105 micron bearings experienced gross wear. The degree of surface distress, weight loss, and probable failure mode were dependent on filtration level, with finer filtration being clearly beneficial. Author

N78-26447*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

GRAPHITE-FIBER-REINFORCED POLYIMIDE LINERS OF VARIOUS COMPOSITIONS IN PLAIN SPHERICAL BEARINGS

Harold E. Sliney and Thomas P. Jacobson Aug. 1978 19 p refs Proposed for presentation at the 2d Intern. Conf. on Solid Lubrication, Denver, 14-18 Aug. 1978; sponsored by the Am. Soc. of Lubrication Engr.

(NASA-TM-78908; E-9296) Avail: NTIS HC A02/MF A01 CSCL 13I

A plain spherical bearing design with a ball diameter of 28.6 mm, a race length of 12.7 mm, and a 1.7-mm-thick, molded composite liner was evaluated. The liner material is a self-lubricating composite of graphite-fiber-reinforced polyimide resin (GFRPI). The liner is prepared by transfer molding a mixture of one part chopped graphite fiber and one part partially polymerized resin into the space between the bearing ball and the outer race and then completing the polymerization under heat and pressure. Several liner compositions were evaluated: two types of polyimide, condensation and addition; two types of graphite fiber, low and high modulus; and four powder additives - cadmium oxide, cadmium iodide, graphite fluoride, and molybdenum disulfide. The bearings were oscillated + or - 15 deg at 1 Hz for 20 kilocycles under a radial unit load of 29 MN sq m (4200 psi) in dry air at 25, 200, or 315 C. Both types of fiber and polyimide gave low friction and wear. A simple equation was developed to fit the wear-time data and adequately predicted wear to 100 kilocycles. Author

N78-26448*# National Aeronautics and Space Administration, Washington, D. C.
A HELIUM ADSORPTION PUMP FOR TEMPERATURES BETWEEN 0.71 AND 1.2 K
G. Frommann and K. Keck Jul. 1978 7 p refs Transl. into ENGLISH from Z. Angew. Phys. (West Germany), vol. 31, nos. 5 and 6, 1971 p 258-260 Transl. by SCITRAN, Santa Barbara, Calif.
(Contract NASw-2791)
(NASA-TM-75336) Avail: NTIS HC A02/MF A01 CSCL 13K

The construction and method of working of a helium adsorption pump are described. The flux of helium-2 film can be suppressed by an appropriate construction, which permits it to reach temperatures down to 0.71 K. By total utilization of the pump's cross-section, temperatures from 1.2 K to 0.71 K remain constant for several hours with a precision of 0.001 K. Author

N78-26449# Aeronautical Systems Div., Wright-Patterson AFB, Ohio.
RECESS FASTENERS Final Report, 1 Sep. - 1 Dec. 1977
E. J. Raimondi Feb. 1978 183 p refs
(AD-A053221; ASD-TR-78-5) Avail: NTIS HC A09/MF A01 CSCL 13/5

This report covers four tasks. A recess fastener test method is developed and the results of tests showing the affect of parameters and comparative recess performance are reported. The results of an investigation into the factors affecting removal torque are reported. An analytical method for determining fastener tensile strength as a function of recess depth is described. Finally, the results of a field data gathering effort to measure torque, end load, and tool angle during installation and removal of fasteners are detailed. Author (GRA)

N78-26450# Hanford Engineering Development Lab., Richland, Wash.
TRIBOLOGY: RESEARCH AND DEVELOPMENT NEEDS IN ADVANCED ENERGY TECHNOLOGY
Roger N. Johnson 1977 30 p refs Presented at the ERDA Workshop on Tribology in Energy Technol. Revised
(Contract EY-76-C-14-2170)
(HEDL-SA-1191-Rev; Conf-770237-1) Avail: NTIS HC A03/MF A01

Poorly controlled wear and friction affects energy conservation, material conservation, and the reliability and safety of mechanical systems, and is estimated to cost U.S. industries $16 billion/yr. The National Friction, Wear, and Self-Welding Program and its accomplishments are described. The program includes studies of wear and friction problems in high temperature and unusual environments, e.g., as experienced by LMFBR components, and common to much technology involving energy conversion using fossil fuel, geothermal, nuclear, and solar resources. Program activities for tribology information handling and wear and friction testing are discussed. Author (ERA)

N78-26451# General Electric Co., San Jose, Calif. Boiling Water Reactor Systems Dept.
RECIRCULATING PUMP SEAL INVESTIGATION. VOLUME 2: TECHNICAL PLANNING STUDY TPS-76-626 Final Report
D. M. Werner Dec. 1977 64 p refs Sponsored by EPRI
(EPRI-NP-351-Vol-2) Avail: NTIS HC A04/MF A01

A review of the BWR recirculation pump seals was conducted as the first step in the possible development of a new pump seal with improved sealing capability and service life. Major seal failure mechanisms were identified and a new seal specification was written. The seal specification established design goals for a low leakage, long life dynamic recirculation pump seal. Existing seal designs including the present face seal configurations, ferrofluidic, visco, hydrostatic face, hydrodynamic face, and bushing seals, were considered. The hydrodynamic spiral groove face seal was judged to be the best replacement for the present face seal design. ERA

N78-26452# General Electric Co., Schenectady, N. Y. Gas Turbine Div.
DEVELOPMENT OF HIGH TEMPERATURE TURBINE SUBSYSTEM TECHNOLOGY TO A TECHNOLOGY READINESS STATUS, PHASE 1 Quarterly Report, Jan. - Mar. 1977
A. Caruvana 24 Jun. 1977 221 p refs
(Contract EX-76-C-01-1806)
(FE-1806-20) Avail: NTIS HC A10/MF A01

Design and analysis details are described for the three combustor designs evaluated including the effects of a 3000 F firing temperature. It is concluded that only the sectoral combustor design has the potential for growth to the 3000 F firing temperature. Thermal and stress analyses of the nozzles and buckets of the TRV turbine are delineated. Design details of these items are included with data on water collection and distribution. The design efforts and evaluations pertinent to the hardware for the backup cooling schemes are described. Analyses include parts lives predictions based on rupture and low cycle fatigue requirements. Various fabrication methods of composite construction were investigated as was investment casting of the large complex shapes expected in the 3d Stage nozzle. ERA

N78-26453# Mechanical Technology, Inc., Latham, N. Y.
HYBRID VEHICLE SIMULATION PROGRAM
A. F. Artiles Sep. 1977 77 p ref Revised
(Contract EY-76-C-02-2835)
(COO-2835-1-Rev; MTI-77TR79) Avail: NTIS HC A05/MF A01

A digital computer program for simulation of a hybrid electric vehicle is presented. User's instructions for preparing input for and simulating the performance of a hybrid vehicle of arbitrary configuration are provided. Sample simulation calculations for a representative electric vehicle as well as for a vehicle powered by a representative Stirling engine are included, and the output is discussed. ERA

N78-26454# California Univ., Livermore. Lawrence Livermore Lab.
THEORETICAL MODEL FOR TWO-PHASE FUEL INJECTION IN STRATIFIED CHARGE ENGINES
L. C. Haselman and C. K. Westbrook May 1977 58 p refs Presented at the Soc. of Automotive Engr. Intern. Automotive Eng. Congr. and Exposition, Detroit, Feb. 1978
(Contract W-7405-eng-48)
(UCRL-79534; Conf-780208-1) Avail: NTIS HC A04/MF A01

A theoretical model was developed for calculations of the evolution of fuel injected into internal combustion engine chambers. Fuel injection in the form of a gaseous jet and in the form of a liquid droplet spray are considered. The model uses the basic equations of conservation of mass, momentum, and energy in both the gaseous and liquid phases. Applications in two dimensional symmetry of the gaseous jet form of the numerical model are described in stagnant coupling between the droplets and the gas phase medium, is described. Applications of the two phase model are described for the case of axially symmetric injection. Finally, the liquid spray model and the gas jet model are applied to the same conditions, leading to a general assessment of the ranges of validity of the gas jet model. ERA

N78-26455# Aeronautical Research Inst. of Sweden, Stockholm. Structures Dept.
SHEAR STRENGTH OF BLIND RIVETS MLS IN STEEL AND ALUMINIUM PLATES
Nils Larsson Jan. 1977 44 p
(FFA-TN-HU-1794) Avail: NTIS HC A03/MF A01

Static tests with MLS blind rivets of 1/8, 5/32, and 3/16 inch diameter (d) are described. Rupture tests were carried out with ordinary and countersunk rivets in steel plates (single-rivet tests), and rupture and deformation tests were carried out with countersunk rivets in single row lap joints in aluminum plates (five-rivet tests). The thickness (t) of the plates was varied between 0.5 and 3.5 mm. The estimated ultimate shear strength (Pult) of ordinary rivets in steel plates was 2350, 3500, and 5100 N for 1/8, 5/32, and 3/16 inch respectively. Countersunk rivets in lap joints reached almost the same values. From curves showing Pult vs d/t and Pult vs t it is obvious that the plate thickness has a marked influence on the strength of the rivets, expecially when countersunk. Deformation curves from thirty-six lap joint tests are presented. Author (ESA)

N78-26456# Bureau of Reclamation, Denver, Colo. Engineering and Research Center.
ESTIMATING REVERSIBLE PUMP-TURBINE CHARACTERISTICS
R. S. Stelzer and R. S. Walter Dec. 1977 47 p refs
(PB-277535/1; Mono-39) Avail: NTIS HC A03/MF A01 CSCL 13B

Data are presented on recent installations of pump-turbines which include figures showing operating characteristics, hydraulic performance, and sizing of the unit. Specific speed, impeller/runner diameter, and the best efficiency head and discharge were selected as the criteria that characterize the unit performance. GRA

N78-26457# Massachusetts Inst. of Tech., Cambridge. Energy Lab.
ISSUES IN FEDERALLY SUPPORTED RESEARCH ON ADVANCED AUTOMOTIVE POWER SYSTEMS Final Report, 1 Jan. - 31 Dec. 1977
Lawrence H. Linden, Subramanyam Kumar, and Paul B. Samuelson Dec. 1977 198 p refs
(Grant NSF PRA-76-81015)
(PB-278124/3; MIT-EL-77-019; NSF/PRA-7681015/1/8) Avail: NTIS HC A09/MF A01 CSCL 21E

Policy issues related to Federal support for R, D, and D on advanced automotive power systems are examined: (1) whether there is any reasonable justification for the Federal Government to support work in this general area at all, (2)what work should be supported on the automotive gas turbine, and (3) strategic choices to be made in the advanced automotive power systems R and D program. Incentives for privately supported research were examined along with impact of emissions and fuel economy regulation. A set of calculations for the value of the automotive gas turbine engine is presented from the social and private viewpoints and the impact on industry behavior during the introduction phase. Author

N78-26238# General Motors Research Labs., Warren, Mich.
STIRLING ENGINE GROUND POWER UNIT Quarterly Report, 17 Jun. - 17 Sep. 1963
F. Earl Heffner *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 1.1: Model 3 Ground Power Units Design, Construct. and Testing. Govt. Contract Rept. Apr. 1978 6 p (For availability see N78-26237 17-31)
(Contract DA-44-009-AMC-250(T))
(GMR-2690-Sect-1.101; QR-1) Avail: NTIS HC A09/MF A01

N78-26239# General Motors Research Labs., Warren, Mich.
STIRLING ENGINE GROUND POWER UNIT Quarterly Report, 18 Sep. - 17 Dec. 1963
F. Earl Heffner *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 1.1: Model 3 Ground Power Units Design, Construct. and Testing. Govt. Contract Rept. Apr. 1978 17 p (For availability see N78-26237 17-31)
(Contract DA-44-009-AMC-250(T))
(GMR-2690-Sect-1.102; QR-2) Avail: NTIS HC A09/MF A01

N78-26240# General Motors Research Labs., Warren, Mich.
STIRLING ENGINE GROUND POWER UNIT Quarterly Report, 18 Dec. 1963 - 17 Mar. 1964
F. Earl Heffner *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 1.1: Model 3 Ground Power Units Design, Construct. and Testing. Govt. Contract Rept. Apr. 1978 10 p (For availability see N78-26237 17-31)
(Contract DA-44-009-AMC-250(T))
(GMR-2690-Sect-1.103; QR-3) Avail: NTIS HC A09/MF A01

N78-26241# General Motors Research Labs., Warren, Mich.
STIRLING ENGINE GROUND POWER UNIT Quarterly Progress Report, 18 Mar. - 17 Jun. 1964
F. Earl Heffner *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 1.1: Model 3 Ground Power Units Design, Construct. and Testing. Govt. Contract Rept. Apr. 1978 5 p (For availability see N78-26237 17-31)
(Contract DA-44-009-AMC-250(T))
(GMR-2690-Sect-1.104; QPR-4) Avail: NTIS HC A09/MF A01

N78-26242# General Motors Research Labs., Warren, Mich.
STIRLING ENGINE GROUND UNIT Quarterly Progress Report, 18 Jun. - 17 Sept. 1964
F. Earl Heffner *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 1.1: Model 3 Ground Power Units Design, Construct. and Testing. Govt. Contract Rept. Apr. 1978 6 p (For availability see N78-26237 17-31)
(Contract DA-44-009-AMC-250(T))
(GMR-2690-Sect-1.105; QPR-5) Avail: NTIS HC A09/MF A01

N78-26243# General Motors Research Labs., Warren, Mich.
STIRLING ENGINE GROUND POWER UNIT Quarterly Progress Report, 18 Sep. 1964 - 31 Jan. 1965
F. Earl Heffner *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 1.1: Model 3 Ground Power Units Design, Construct. and Testing. Govt. Contract Rept. Apr. 1978 11 p (For availability see N78-26237 17-31)
(Contract DA-44-009-AMC-250(T))
(GMR-2690-Sect-1.106; QPR-6) Avail: NTIS HC A09/MF A01

N78-26244# General Motors Research Labs., Warren, Mich.
STIRLING ENGINE GROUND POWER UNIT Quarterly Progress Report, 1 Feb. - 30 Apr. 1965
F. Earl Heffner *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 1.1: Model 3 Ground Power Units Design, Construct. and Testing. Govt. Contract Rept. Apr. 1978 6 p (For availability see N78-26237 17-31)
(Contract DA-44-009-AMC-250(T))
(GMR-2690-Sect-1.107; QPR-7) Avail: NTIS HC A09/MF A01

N78-26245# General Motors Research Labs., Warren, Mich.
STIRLING ENGINE GROUND POWER UNIT Quarterly Progress Report, 1 May - 31 Jul. 1965
F. Earl Heffner *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 1.1: Model 3 Ground Power Units Design, Construct. and Testing. Govt. Contract Rept. Apr. 1978 12 p (For availability see N78-26237 17-31)
(Contract DA-44-009-AMC-250(T))
(GMR-2690-Sect-1.108; QPR-8) Avail: NTIS HC A09/MF A01

N78-26246# General Motors Research Labs., Warren, Mich.
STIRLING ENGINE GROUND POWER UNIT Final Progress Report, 1 Aug. 1965 - 15 Apr. 1966
F. Earl Heffner *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 1.1: Model 3 Ground Power Units Design, Construct. and Testing. Govt. Contract Rept. Apr. 1978 10 p (For availability see N78-26237 17-31)
(Contract DA-44-009-AMC-250(T))
(GMR-2690-Sect-1.109) Avail: NTIS HC A09/MF A01

N78-26247# General Motors Research Labs., Warren, Mich.
STIRLING ENGINE GROUND POWER UNIT MODEL GPU 3 ACCEPTANCE TEST REPORT
F. Earl Heffner *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 1.1: Model 3 Ground Power Units Design, Construct. and Testing. Govt. Contract Rept. Apr. 1978 19 p (For availability see N78-26237 17-31)
(GMR-2690-Sect-1.110) Avail: NTIS HC A09/MF A01

N78-26248# General Motors Research Labs., Warren, Mich.
MANUAL AND PARTS LIST FOR STIRLING GROUND POWER UNITS, MODEL GPU-3
F. Earl Heffner, Raymond M. Cole, and Richard R. Toepel *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 1.1: Model 3 Ground Power Units Design, Construct. and Testing. Govt. Contract Rept. Apr. 1978 53 p (For availability see N78-26237 17-31)
(Contract DA-44-009-AMC-250(T))
(GMR-2690-Sect-1.111) Avail: NTIS HC A09/MF A01

N78-26249# General Motors Research Labs., Warren, Mich.
US ARMY ENGINEER RESEARCH AND DEVELOPMENT LABORATORIES FIVE HUNDRED HOUR ENGINEERING EVALUATION OF THE STIRLING GPU 2-1

F. Earl Heffner *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 1.1: Model 3 Ground Power Units Design, Construct. and Testing. Govt. Contract Rept. Apr. 1978 24 p (For availability see N78-26237 17-31)
(GMR-2690-Sect-1.112) Avail: NTIS HC A09/MF A01

N78-26251# General Motors Research Labs., Warren, Mich.
EFFECT OF DIESEL FUEL ON STIRLING ENGINE GROUND POWER UNIT COMPONENTS
Richard R. Toepel *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 1.2: Model 3 Ground Power Units Design, Construct., and Testing, Gen. Motors Res. Studies Apr. 1978 9 p refs (For availability see N78-26250 17-31)
(GMR-2690-Sect-1.201) Avail: NTIS HC A12/MF A01

N78-26252# General Motors Research Labs., Warren, Mich.
MANUAL CRANKING TESTS OF THE STIRLING ENGINE GROUND POWER UNIT
Richard R. Toepel *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 1.2: Model 3 Ground Power Units Design, Construct., and Testing, Gen. Motors Res. Studies Apr. 1978 14 p (For availability see N78-26250 17-31)
(GMR-2690-Sect-1.202) Avail: NTIS HC A12/MF A01

N78-26253# General Motors Research Labs., Warren, Mich.
THE GPU-3 STIRLING ENGINE GROUND POWER UNIT IGNITION SYSTEM
Richard R. Toepel *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 1.2: Model 3 Ground Power Units Design, Construct., and Testing, Gen. Motors Res. Studies Apr. 1978 9 p (For availability see N78-26250 17-31)
(GMR-2690-Sect-1.203) Avail: NTIS HC A12/MF A01

N78-26254# General Motors Research Labs., Warren, Mich.
COMBUSTOR DEVELOPMENT FOR STIRLING GROUND POWER UNITS, GPU-2 AND GPU-3
Robert E. Sullivan *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 1.2: Model 3 Ground Power Units Design, Construct., and Testing, Gen. Motors Res. Studies Apr. 1978 53 p ref (For availability see N78-26250 17-31)
(GMR-2690-Sect-1.204) Avail: NTIS HC A12/MF A01

N78-26255# General Motors Research Labs., Warren, Mich.
THE EFFECT OF A BYPASS VALVE ON STIRLING ENGINE BRAKING ABILITY
Robert J. Bayer *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 1.2: Model 3 Ground Power Units Design, Construct., and Testing, Gen. Motors Res. Studies Apr. 1978 25 p (For availability see N78-26250 17-31)
(GMR-2690-Sect-1.205) Avail: NTIS HC A12/MF A01

N78-26256# General Motors Research Labs., Warren, Mich.
PRELIMINARY PERFORMANCE TESTS OF A GPU-3 STIRLING ENGINE ON HYDROGEN, HELIUM, AND NITROGEN
James E. Bennethum *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 1.2: Model 3 Ground Power Units Design, Construct., and Testing, Gen. Motors Res. Studies Apr. 1978 14 p (For availability see N78-26250 17-31)
(GMR-2690-Sect-1.206) Avail: NTIS HC A12/MF A01

N78-26257# General Motors Research Labs., Warren, Mich.
STIR-LEC 2 STIRLING ENGINE PERFORMANCE
Richard R. Toepel *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 1.2 Model 3 Ground Power Units Design, Construct., and Testing, Gen. Motors Res. Studies Apr. 1978 5 p ref (For availability see N78-26250 17-31)
(GMR-2690-Sect-1.207) Avail: NTIS HC A12/MF A01

N78-26258# General Motors Research Labs., Warren, Mich.
METHOD OF TESTS AND INSTRUCTIONS (GENERATOR SETS, STIRLING ENGINE DRIVE)
Raymond M. Cole *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 1.2: Model 3 Ground Power Units Design, Construction, and Testing, Gen. Motors Res. Studies Apr. 1978 37 p (For availability see N78-26250 17-31)
(GMR-2690-Sect-1.208) Avail: NTIS HC A12/MF A01

N78-26259# General Motors Research Labs., Warren, Mich.
GPU 3-3 PROTOTYPE PRODUCT DEMONSTRATION TESTS
Raymond M. Cole and Kenneth J. Stukas *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 1.2: Model 3 Ground Power Units Design, Construct., and Testing, Gen. Motors Res. Studies Apr. 1978 57 p refs (For availability see N78-26250 17-31)
(GMR-2690-Sect-1.209) Avail: NTIS HC A12/MF A01

N78-26260# General Motors Research Labs., Warren, Mich.
STIRLING ENGINE TESTS SIMULATING UNDERWATER TES OPERATION
John H. Lienesch *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 1.2: Model 3 Ground Power Units Design, Construct., and Testing, Gen. Motors Res. Studies Apr. 1978 12 p ref (For availability see N78-26250 17-31)
(GMR-2690-Sect-1.210) Avail: NTIS HC A12/MF A01

N78-26263# General Motors Research Labs., Warren, Mich.
AN ANALYTICAL TREATMENT OF THE STIRLING CYCLE ENGINE
John R. Altenhoff, Richard L. Justice, and Donald R. Olson *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 2: Stirling Cycle Anal. and Eng. Design Studies Apr. 1978 19 p (For availability see N78-26262 17-31)
(GMR-2690-Sect-2.101) Avail: NTIS HC A14/MF A01

N78-26265# General Motors Research Labs., Warren, Mich.
STIRLING CYCLE ENGINE PARAMETER STUDY
Richard L. Justice *In its* A collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 2: Stirling Cycle Anal. and Eng. Design Studies Apr. 1978 8 p (For availability see N78-26262 17-31)
(GMR-2690-Sect-2.103) Avail: NTIS HC A14/MF A01

N78-26270# General Motors Research Labs., Warren, Mich.
THE EVOLUTION OF A PRACTICAL ENGINE FROM THE IDEAL STIRLING CYCLE AND THE RESULTING LOSSES
James E. Bennethum *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 2: Stirling Cycle Anal. and Eng. Design Studies Apr. 1978 13 p (For availability see N78-26262 17-31)
(GMR-2690-Sect-2.108) Avail: NTIS HC A14/MF A01

N78-26273# General Motors Research Labs., Warren, Mich.
A COMPARISON OF THE CALCULATED AND MEASURED INFLUENCE OF LONG CONNECTING DUCTS ON STIRLING ENGINE PERFORMANCE
James E. Bennethum *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 2: Stirling Cycle Anal. and Eng. Design Studies Apr. 1978 6 p ref (For availability see N78-26262 17-31)
(GMR-2690-Sect-2.111) Avail: NTIS HC A14/MF A01

N78-26277# General Motors Research Labs., Warren, Mich.
CALCULATED 4L23 STIRLING ENGINE PERFORMANCE
Robbert Diepenhorst *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 2: Stirling Cycle Anal. and Eng. Design Studies Apr. 1978 19 p (For availability see N78-26262 17-31)
(GMR-2690-Sect-2.115) Avail: NTIS HC A14/MF A01

N78-26278# General Motors Research Labs., Warren, Mich.
CALCULATED ENGINE PERFORMANCE AND PERFORMANCE CORRECTION CURVES FOR MODELS GPU-3, 30-15, 80-15 AND 4L23 STIRLING ENGINES
Robbert Diepenhorst and Charles W. Cooper *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 2: Stirling Cycle Anal. and Eng. Design Studies Apr. 1978

38 p (For availability see N78-26262 17-31)
(GMR-2690-Sect-2.116) Avail: NTIS HC A14/MF A01

N78-26282# General Motors Research Labs., Warren, Mich.
A SIMPLIFIED SIZE COMPARISON OF MULTI-CYLINDER STIRLING ENGINES WITH DIFFERENT DRIVE MECHANISMS
Robbert Diepenhorst *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 2: Stirling Cycle Anal. and Eng. Design Studies Apr. 1978 10 p (For availability see N78-26262 17-31)
(GMR-2690-Sect-2.204) Avail: NTIS HC A14/MF A01

N78-26283# General Motors Research Labs., Warren, Mich.
BASIC DESIGN OF THE MOST COMPACT STATE-OF-THE-ART STIRLING ENGINE
John H. Lienesch *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 2: Stirling Cycle Anal. and Eng. Design Studies Apr. 1978 29 p refs (For availability see N78-26262 17-31)
(GMR-2690-Sect-2.205) Avail: NTIS HC A14/MF A01

N78-26289# General Motors Research Labs., Warren, Mich.
EXAMINATION OF STIRLING ENGINE REGENERATOR SCREENS
J. E. Hunter and S. W. Iwankovitsch *In its* A Collection of Stirling Engine Reports from General Motors' Research, 1958 to 1970. Part 3: Stirling Engine Materials and Stresses, 3.1 Stirling Engine Materials, 3.2 Stirling Engine Stresses Apr. 1978 9 p refs (For availability see N78-26284 17-31)
(GMR-2690-Sect-3.105) Avail: NTIS HC A10/MF A01

N78-26297# General Motors Research Labs., Warren, Mich.
STIRLING CYLINDER DEFORMATION MEASUREMENT
James R. Abel and Raymond M. Cole *In its* A Collection of Stirling Engine Reports from General Motors' Res., 1958 to 1970. Pt 3: Stirling Engine Materials and Stresses, 3.1 Stirling Engine Materials, 3.2 Stirling Engine Stresses Apr. 1978 11 p (For availability see N78-26284 17-31)
(GMR-2690-Sect-3.207) Avail: NTIS HC A10/MF A01

N78-26300# General Motors Research Labs., Warren, Mich.
STIRLING THERMAL ENGINE SEAL TEST REPORT 1: LEAK RATES OF COMMERCIAL RECIPROCATING SEALS AGAINST 1500 PSI HELIUM
F. Earl Heffner and Robert Diepenhorst *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 4: Piston Rod Seals, 4.1 Sliding Seals, 4.2 Rolling Diaphragms Apr. 1978 24 p (For availability see N78-26299 17-31)
(GMR-2690-Sect-4.101) Avail: NTIS HC A12/MF A01

N78-26301# General Motors Research Labs., Warren, Mich.
GPU-3 STIRLING ENGINE MAXIMUM COMPRESSION SPACE TEMPERATURE ENDURANCE TESTS. PART 1: SLIDING SEALS
Ismail R. Hoyi and Carl A. Schiele *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 4: Piston Rod Seals, 4.1 Sliding Seals, 4.2 Rolling Diaphragms Apr. 1978 45 p refs (For availability see N78-26299 17-31)
(GMR-2690-Sect-4.102) Avail: NTIS HC A12/MF A01

N78-26302# General Motors Research Labs., Warren, Mich.
STIRLING THERMAL ENGINE SEAL TEST REPORT 2: PROGRESS ON THE ROLLING SEAL, NOVEMBER 1962 TO MAY 1963
William H. Ahrens *In its* A Collection of Stirling Eng. Rept. from Gen Motors' Res., 1958 to 1970. Pt. 4: Piston Rod Seals, 4.1 Sliding Seals, 4.2 Rolling Diaphragms Apr. 1978 18 p ref (For availability see N78-26299 17-31)
(GMR-2690-Sect-4.201) Avail: NTIS HC A12/MF A01

N78-26303# General Motors Research Labs., Warren, Mich.
STIRLING THERMAL ENGINE SEAL TEST REPORT 3: INITIAL GMR ROLLING SEAL TESTS, MAY 1963 TO OCTOBER 1963
William H. Ahrens *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 4: Piston Rod Seals, 4.1 Sliding Seals, 4.2 Rolling Diaphragms Apr. 1978 6 p (For availability see N78-26299 17-31)
(GMR-2690-Sect-4.202) Avail: NTIS HC A12/MF A01

N78-26304# General Motors Research Labs., Warren, Mich.
STIRLING THERMAL ENGINE SEAL TEST REPORT 4: QUALITY CONTROL PROGRAM FOR MOLDING AND TESTING ROLLING SEALS
William H. Ahrens *In its* A Collection of Stirling Eng. Rept., from Gen. Motors' Res., 1958 to 1970. Pt. 4: Piston Rod Seals, 4.1 Sliding Seals, 4.2 Rolling Diaphragms Apr. 1978 6 p (For availability see N78-26299 17-31)
(GMR-2690-Sect-4.203) Avail: NTIS HC A12/MF A01

N78-26306# General Motors Research Labs., Warren, Mich.
STIRLING ENGINE ROLLING SEAL Progress Report, Nov. - Dec. 1962
Harold E. Trexler *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 4: Piston Rod Seals, 4.1 Sliding Seals, 4.2 Rolling Diaphragms Apr. 1978 8 p (For availability see N78-26299 17-31)
(GMR-2690-Sect-4.205) Avail: NTIS HC A12/MF A01

N78-26307# General Motors Research Labs., Warren, Mich.
ELASTOMER ROLLING SEAL FOR STIRLING ENGINE
Harold E. Trexler *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 4: Piston Rod Seals, 4.1 Sliding Seals, 4.2 Rolling Diaphragms Apr. 1978 11 p (For availability see N78-26299 17-31)
(GMR-2690-Sect-4.206) Avail: NTIS HC A12/MF A01

N78-26308# General Motors Research Labs., Warren, Mich.
ELASTOMER ROLLING SEAL FOR STIRLING ENGINE.
Harold E. Trexler *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 4: Piston Rod Seals, 4.1 Sliding Seals, 4.2 Rolling Diaphragms Apr. 1978 15 p (For availability see N78-26299 17-31)
(GMR-2690-Sect-4.207) Avail: NTIS HC A12/MF A01

N78-26309# General Motors Research Labs., Warren, Mich.
STIRLING ENGINE ROLLING SEAL CONTROL SYSTEMS
Richard R. Toepel *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 4: Piston Rod Seals, 4.1 Sliding Seals, 4.2 Rolling Diaphragms Apr. 1978 11 p ref (For availability see N78-26299 17-31)
(GMR-2690-Sect-4.208) Avail: NTIS HC A12/MF A01

N78-26314# General Motors Research Labs., Warren, Mich.
PERFORMANCE TESTING OF POWER PISTON SEALS FOR THE STIRLING THERMAL ENGINE
Robert J. Bayer *In its* A Collection of Stirling Eng. Repts. from General Motors' Res., 1958 to 1970. Part 5: Piston Seals Apr. 1978 26 p (For availability see N78-26312 17-31)
(GMR-2690-Sect-5.002) Avail: NTIS HC A06/MF A01

N78-26315# General Motors Research Labs., Warren, Mich.
STIRLING THERMAL ENGINE POWER PISTON PUMPING LOSS - EXPERIMENTAL AND THEORETICAL RESULTS
David K. Dorer *In its* A Collection of Stirling Eng. Repts. from General Motors' Res., 1958 to 1970. Part 5: Piston Seals Apr. 1978 34 p (For availability see N78-26312 17-31)
(GMR-2690-Sect-5.003) Avail: NTIS HC A06/MF A01

N78-26316# General Motors Research Labs., Warren, Mich.
PUMPING POWER LOSS EQUATIONS FOR THREE TYPICAL STIRLING THERMAL ENGINE CASES
David K. Dorer *In its* A Collection of Stirling Eng. Repts. from General Motors' Res., 1958 to 1970. Part 5: Piston Seals Apr. 1978 11 p (For availability see N78-26312 17-31)
(GMR-2690-Sect-5.004) Avail: NTIS HC A06/MF A01

N78-26317# General Motors Research Labs., Warren, Mich.
POWER LOSS ASSOCIATED WITH STIRLING THERMAL ENGINE DISPLACER PISTON VENTING
David K. Dorer *In its* A Collection of Stirling Eng. Repts. from General Motors' Res., 1958 to 1970. Part 5: Piston Seals Apr. 1978 9 p (For availability see N78-26312 17-31)
(GMR-2690-Sect-5.005) Avail: NTIS HC A06/MF A01

N78-26319# General Motors Research Labs., Warren, Mich.
STIRLING THERMAL ENGINE REGENERATOR COST REDUCTION PROGRAM OUTLINE
John C. Steiner *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 6: Regenerators Apr. 1978 5 p (For availability see N78-26318 17-31)
(GMR-2690-Sect-6.001) Avail: NTIS HC A06/MF A01

N78-26321# General Motors Research Labs., Warren, Mich.
STIRLING ENGINE REGENERATOR PERFORMANCE ANALYSIS
James R. Mondt *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 6: Regenerators Apr. 1978 25 p refs (For availability see N78-26318 17-31)
(GMR-2690-Sect-6.003) Avail: NTIS HC A06/MF A01

N78-26322# General Motors Research Labs., Warren, Mich.
STIRLING THERMAL ENGINE REGENERATOR COST REDUCTION PROGRAM. REPORT 2: JUNE 1965 STATUS
John C. Steiner *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 6: Regenerators Apr. 1978 23 p refs (For availability see N78-26318 17-31)
(GMR-2690-Sect-6.004) Avail: NTIS HC A06/MF A01

N78-26323# General Motors Research Labs., Warren, Mich.
STIRLING THERMAL ENGINE REGENERATOR COST REDUCTION PROGRAM. REPORT 3: MANUFACTURING THE ELECTRO-MOTIVE DIVISION 4S/8V12C STIRLING ENGINE REGENERATORS
John C. Steiner and Robert Diepenhorst *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 6: Regenerators Apr. 1978 17 p refs (For availability see N78-26318 17-31)
(GMR-2690-Sect-6.005) Avail: NTIS HC A06/MF A01

N78-26324# General Motors Research Labs., Warren, Mich.
STIRLING THERMAL ENGINE REGENERATOR COST REDUCTION PROGRAM. REPORT 4: MET NET FLUID FRICTION HEAT TRANSFER TEST RESULTS, ENGINE TEST FOR FOUR REGENERATION MATERIALS
John C. Steiner *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 6: Regenerators Apr. 1978 45 p refs (For availability see N78-26318 17-31)
(GMR-2690-Sect-6.006) Avail: NTIS HC A06/MF A01

N78-26325# General Motors Research Labs., Warren, Mich.
A PROCEDURE FOR FLAME SPRAYING METNET REGENERATORS
John H. Lienesch *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 6: Regenerators Apr. 1978 11 p ref (For availability see N78-26318 17-31)
(GMR-2690-Sect-6.007) Avail: NTIS HC A06/MF A01

N78-26331# General Motors Research Labs., Warren, Mich.
EXAMINATION OF CALVAIR STIRLING ENGINE BRAZED TEST ASSEMBLY AFTER EXPOSURE TO MOLTEN LiOH
John N. Johnson *In its* A Collection of Stirling Eng. Rept. from Gen. Motors; Res., 1958 to 1970. Pt. 7: Thermal energy Storage and Publ. List, 7.1 Thermal Energy Storage, 7.2 List of Gen. Motors Stirling Eng. Publ. Apr. 1978 12 p (For availability see N78-26326 17-31)
(GMR-2690-Sect-7.105) Avail: NTIS HC A11/MF A01

38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

N78-26458*# Massachusetts Inst. of Tech., Cambridge.
ACOUSTIC EMISSION DURING UNLOADING OF ELASTICALLY STRESSED MAGNESIUM ALLOY Final Report
Samson S. Lee and James H. Williams, Jr. Jun. 1977 20 p refs
(Grant NsG-3064)
(NASA-CR-2840) Avail: NTIS HC A02/MF A01 CSCL 14D

A magnesium alloy was quasi-statically cycled elastically between zero load and tension. Both loading and unloading stress delays were found, and the unloading stress delay was further studied. An analytical expression was written for the unloading stress delay which is an elastic constitutive parameter. The potential use of these results for the acoustic emission monitoring of elastic stress states is discussed. Author

N78-26459# Royal Aircraft Establishment, Farnborough (England).
EXPERIENCE GAINED IN NON-DESTRUCTIVE TESTING OF HIGH-STRESS STRUCTURAL ELEMENTS USING THE DC-POTENTIAL PROBE METHOD
E. Kloth, M. Strasser, and B. C. Fisher, ed. Oct. 1977 9 p refs Transl. into ENGLISH from Materialpruefung (West Germany), v. 17, no. 7, 1975 p 224-225
(RAE-Lib-Trans-1941; BR62772) Avail: NTIS HC A02/MF A01

The potential probe method involves the measurement of the electrical field distribution at the surface of components through which current is flowing for purposes of checking cracks and of determining wall thickness. The technique is particularly useful for the detection of cracks reaching the surface of work pieces of complex shape and to the quantitative determination of their depth and position. A.R.H.

N78-26460# Advisory Group for Aerospace Research and Development, Paris (France).
NON-DESTRUCTIVE INSPECTION RELATIONSHIPS TO AIRCRAFT DESIGN AND MATERIALS
Mar. 1978 336 p refs In ENGLISH and FRENCH Presented at the 45th Meeting of the AGARD Struct. and Mater. Panel, Voss, Norway, 27-28 Sep. 1977
(AGARD-CP-234; ISBN-92-835-0213-2) Avail: NTIS HC A15/MF A01

The state of the art of nondestructive inspection methods for materials of interest to the aerospace industry is considered along with the weak points of some methods and the trends of application. Composite, ceramic, and metallic materials are included. Low angle neutron scattering, digitalized infrared thermography, tomography, and very high frequency ultrasonic beam scattering are among the methods discussed. For individual titles, see N78-26461 through N78-26480.

N78-26461# Aeritalia S.p.A., Torino (Italy).
NDI TECHNIQUES IN AEROSPACE
Enrico Bolis *In* AGARD Non-destructive Inspection Relationships to Aircraft Design and Mater. Mar. 1978 3 p (For availability see N78-26460 17-38)
Avail: NTIS HC A15/MF A01

The application of nondestructive inspection techniques to assure the safety and reliability of aerospace structures and components is discussed. The importance of quality assurance techniques and standards at all levels of development (materials procurement, engineering specifications, structures manufacturing) and in monitoring structures during service life is emphasized. J.M.S.

N78-26462# Politecnico di Torino (Italy). Inst. Progetto di Aeromobili.
CRITICAL REVIEW OF VARIOUS STRUCTURAL SAFETY CONCEPTS TAKING INTO ACCOUNT NDI METHODS
E. Antona *In* AGARD Non-destructive Inspection Relationships to Aircraft Design and Mater. Mar. 1978 22 p refs (For availability see N78-26460 17-38)
(Contract CNR-SAS-76-0031)
Avail: NTIS HC A15/MF A01

A critical review is given of the various structural safety concepts adopted during the aeronautical and space technology development, with particular emphasis on fatigue and fracture mechanics. A comparison is made between the deterministic and the probabilistic point of view in the analysis of the loading condition and the structural behavior and consequently between the deterministic and the probabilistic formulation of the structural safety concepts. As a conclusion to these considerations an analysis is performed relative to the present and the expected

impact of fracture mechanics in aerospace structural design philosophy and to the impact of nondestructive inspection methods on fracture mechanics analysis. J.M.S.

N78-26463# Air Force Materials Lab., Wright-Patterson AFB, Ohio.
THE ECONOMIC IMPLICATIONS OF NDE: OPPORTUNITIES AND PAYOFF
D. M. Forney and T. D. Cooper *In* AGARD Non-destructive Inspection Relationships to Aircraft Design and Mater. Mar. 1978 15 p refs (For availability see N78-26460 17-38)
Avail: NTIS HC A15/MF A01

Progress in the development of nondestructive evaluation procedures which may have significant economic benefits is reviewed. Nondestructive evaluation requirements in both initial manufacturing and in-service functions are discussed to exemplify cost effective approaches. Other possible future opportunities are also considered. J.M.S.

N78-26464# Royal Air Force, London (England).
UNFULFILLED NEEDS OF NON-DESTRUCTIVE INSPECTION OF MILITARY AIRCRAFT
H. M. Kent *In* AGARD Non-destructive Inspection Relationships to Aircraft Design and Mater. Mar. 1978 10 p refs (For availability see N78-26460 17-38)
Avail: NTIS HC A15/MF A01

The research and development needs of nondestructive inspection technology are discussed in terms of maintaining the airworthiness of military aircraft. Techniques for in-flight monitoring and detection of defects due to corrosion, residual and thermal stress, and adhesive bond deterioration are included. J.M.S.

N78-26465# Fiat Research Center, Orbassano (Italy).
APPLICATION OF SMALL-ANGLE NEUTRON SCATTERING TO NDI OF MATERIALS AND MANUFACTURED COMPONENTS
P. Pizzi *In* AGARD Non-destructive Inspection Relationships to Aircraft Design and Mater. Mar. 1978 17 p refs (For availability see N78-26460 17-38)
Avail: NTIS HC A15/MF A01

Examples of heat treatment effects, cold work effects, and creep effects measured by small angle neutron scattering are presented. Application of the small angle neutron scattering technique to the study of microstructural degradation phenomena in nickel superalloys and in particular in turbine blades during service is discussed. An example of anisotropic scattering measured in carbon-carbon fiber composites is included. J.M.S.

N78-26466# Fiat Research Center, Orbassano (Italy).
SURFACE CORROSION EVALUATION BY RELATIVE MAGNETIC SUSCEPTIBILITY MEASUREMENTS
H. Walther *In* AGARD Non-destructive Inspection Relationships to Aircraft Design and Mater. Mar. 1978 11 p ref (For availability see N78-26460 17-38)
Avail: NTIS HC A15/MF A01

A method based on the principles of a magnetic balance is proposed for detecting the corrosion effects in the very early stage of the degeneration process. The method is based on the fact that superalloys and stainless steels change their magnetic susceptibility during oxidation and carburization in their subsurface layer. Results of measurements performed on IN-100 aircraft turbine blades and INCONEL X-750 power plant gas turbine blades are reported. J.M.S.

N78-26467# Lanchester Polytechnic, Coventry (England).
APPLICATION OF X-RAY DIFFRACTION STRESS MEASURING TECHNIQUES
D. Kirk *In* AGARD Non-destructive Inspection Relationships to Aircraft Design and Mater. Mar. 1978 13 p refs (For availability see N78-26460 17-38)
Avail: NTIS HC A15/MF A01

Examples of residual stress analysis are given to illustrate the wide range of useful applications that are possible for the X-ray stress measuring techniques. The variation of residual stress at the surface for a machined aluminum alloy extrusion and for the region adjacent to a butt-welded steel plate is discussed along with the variation of residual stress below the original surface for shot-peened components and for a flow-formed maraging steel tube. The advantages of chemical polishing for layer removal are considered. The practical problems associated with unusual geometry and physical size of components are described. J.M.S.

N78-26468# Direzione Laboratori Aeronautica Militaire, Rome (Italy).
X-RAY DIFFRACTION: FROM STRUCTURAL X-RAY DIFFRACTOGRAPHY TO X-RAY OSCILLOGRAPHIC DIFFRACTOSCOPY
Angelo Tronca *In* AGARD Non-destructive Inspection Relationships to Aircraft Design and Mater. Mar. 1978 12 p refs (For availability see N78-26460 17-38)
Avail: NTIS HC A15/MF A01

Fast inspection of jet engine compressor blades is considered. Classical X-ray diffractography which utilizes filtered radiation and plane X-ray films and oscillographic fast inspection are described. Results obtained by each method are presented and correlated. Oscillographic observations of rotating compressor steel blades are reported. J.M.S.

N78-26469# Saab-Scania, Linkoping (Sweden). Aerospace Div.
ON THE DETECTION AND MEASUREMENT OF CRACKS IN CRITICALLY LOADED HOLES
Sven Malmquist *In* AGARD Non-destructive Inspection Relationships to Aircraft Design and Mater. Mar. 1978 3 p (For availability see N78-26460 17-38)
Avail: NTIS HC A15/MF A01

A method developed for the inspection of the surface of a hole with the bolt removed is described. A stereomicroscope and a mirror in the hole, a surface roughness meter, and an eddy current instrument are used in the inspection. Scratches, cracks, corrosion, and fretting corrosion damages are observed with the stereomicroscope and mirror. The depth of scratches is measured with a surface roughness meter, Surtonic 3, which was modified for this purpose. Scratches that have grown into cracks are indicated and measured with an eddy current technique. J.M.S.

N78-26470# Middle East Technical Univ., Ankara (Turkey). Dept. of Metallurgical Engineering.
DYNAMIC NONDESTRUCTIVE TESTING OF MATERIALS
E. M. Uygur *In* AGARD Non-destructive Inspection Relationships to Aircraft Design and Mater. Mar. 1978 43 p refs (For availability see N78-26460 17-38)
Avail: NTIS HC A15/MF A01

It is shown that damping or internal friction and frequency measurements can be used for flaw detection and quality control as well as measurements of physical properties. Application areas and instrumentation used are discussed. J.M.S.

N78-26471# Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (West Germany).
NDI METHODS ON FULL-SCALE FATIGUE TESTS AND THEIR SERVICE USAGE
Richard Schuetz *In* AGARD Non-destructive Inspection Relationships to Aircraft Design and Mater. Mar. 1978 22 p refs (For availability see N78-26460 17-38)
Avail: NTIS HC A15/MF A01

Procedures used to select the most effective nondestructive inspection methods and intervals are outlined. The problem of fatigue damages undetected by nondestructive inspection during full scale fatigue testing are discussed. J.M.S.

N78-26472# Southwest Research Inst., San Antonio, Tex.
CRITICAL INSPECTION OF BEARINGS FOR LIFE EXTENSION
John R. Barton, Felix N. Kusenberger, and Richard T. Smith *In* AGARD Non-destructive Inspection Relationships to Aircraft Design and Mater. Mar. 1978 29 p refs (For availability see N78-26460 17-38)
Avail: NTIS HC A15/MF A01

Research with the object of developing more definite nondestructive inspection methods for improved reliability and quality of rolling element bearings is reviewed. Inspection of precision mainshaft and transmission bearing assemblies in which the individual components -- outer race, rolling elements, (balls

or rollers) and inner race -- can be separated is emphasized. Results obtained with magnetic perturbation for flaw detection, Barkhausen Noise Analysis for residual stress assessment, and laser scattered radiation for surface finish and surface anomaly detection are presented. The critical inspection of bearings for life extension program concept is described; a cardinal element of this program is the examination of new and used bearings, installation of the bearings in gas turbine engines, re-examination of bearings at engine overhaul, and the development of serviceability criteria based on actual service performance of the bearings in engines. J.M.S.

N78-26473# Saab-Scania, Linkoping (Sweden). Aerospace Div.

CRACK DETECTION IN BOLTED JOINTS

Lars Jarfall and Ake Magnusson *In* AGARD Non-destructive Inspection Relationships to Aircraft Design and Mater. Mar. 1978 5 p Prepared in cooperation with Aeronautical Research Inst. of Sweden, Bromma (For availability see N78-26460 17-38)
Avail: NTIS HC A15/MF A01

Fatigue cracks were generated from holes in sheet materials by application of fatigue loading to one hole at a time. From the cracked sheet material, a number of single shear two row lap joints were made. The lap joints were subjected to nondestructive testing (NDT). The ultrasonics method, the X-ray method, and the eddy current method were carried out and results compared. J.M.S.

N78-26474# Royal Aircraft Establishment, Farnborough (England). Structures Dept.

NON-DESTRUCTIVE INSPECTION OF COMPOSITE MATERIALS FOR AIRCRAFT STRUCTURAL APPLICATIONS

D. E. W. Stone *In* AGARD Non-destructive Inspection Relationships to Aircraft Design and Mater. Mar. 1978 18 p refs (For availability see N78-26460 17-38)
Avail: NTIS HC A15/MF A01

The capabilities and limitations of various nondestructive inspection techniques to detect defects in fiber reinforced plastics are reviewed. Emphasis is placed on carbon fiber reinforced plastics. Difficulties in transferring laboratory techniques to prototype and production structural components are discussed along with problem areas. The role of acoustic emission in nondestructive inspection is considered. J.M.S.

N78-26475# Royal Netherlands Aircraft Factories Fokker, Schiphol-Oost. Technological Centre.

THE RESONANCE-IMPEDANCE METHOD AS A MEANS FOR QUALITY CONTROL OF ADVANCED FIBRE REINFORCED PLASTIC STRUCTURES

R. J. Schliekelmann *In* AGARD Non-destructive Inspection Relationships to Aircraft Design and Mater. Mar. 1978 16 p refs (For availability see N78-26460 17-38)
Avail: NTIS HC A15/MF A01

The principles of the resonance frequency/impedance method are discussed. Detection of laminate thickness variations, matrix density variations, and delaminations is considered along with application of the method to inspection of advanced composite structures. J.M.S.

N78-26476# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).

INSPECTION OF CARBON FIBRE PARTS AFTER FABRICATION AND DURING SERVICE

Michael Kaitatzidis *In* AGARD Non-destructive Inspection Relationships to Aircraft Design and Mater. Mar. 1978 16 p (For availability see N78-26460 17-38)
Avail: NTIS HC A15/MF A01

The individual parts of the Alpha Jet carbon fiber plastic airbrake were subjected to nondestructive testing by means of ultrasonics and X-rays. Quantity and size of the laminate flaws detected are reported along with adhesive defects in advanced composite structures. The experience gained during the inspection of the prototype airbrakes is described and prospects for proceeding in this field are considered. J.M.S.

N78-26477# Vereinigte Flugtechnische Werke-Fokker G.m.b.H., Lemwerder (West Germany). Materials and Processes Development Dept.

DETECTABILITY OF FLAWS IN BORON AND CARBON COMPOSITE PARTS

Gustav Tober and Hilmar Schnell *In* AGARD Non-destructive Inspection Relationships to Aircraft Design and Mater. Mar. 1978 14 p (For availability see N78-26460 17-38)
Avail: NTIS HC A15/MF A01

The experience gained in nondestructive testing in the development of boron fiber reinforced plastics and carbon fiber reinforced plastics is discussed. The soft X-ray technique, ultrasonic, acoustic flaw detector, sonic resonator, holography, and tapping test are among the methods described. Types of faults detected by each method are reported along with the capacity of each method for practical use. J.M.S.

N78-26478# Laboratoire Central Aerospatiale, Suresnes Cedex (France).

THE PRESENT STATUS AND EVOLUTION OF THE INSPECTION OF CARBON COMPOSITE AIRCRAFT STRUCTURES IN FRANCE [ETAT ACTUEL ET EVOLUTION EN FRANCE DU CONTROLE DE STRUCTURES D'AVION EN COMPOSITES CARBONE]

M. Treca *In* AGARD Non-destructive Inspection Relationships to Aircraft Design and Mater. Mar. 1978 7 p refs In FRENCH (For availability see N78-26460 17-38)
Avail: NTIS HC A15/MF A01

A number of nondestructive test methods utilized for the inspection of composite aircraft structures were studied. These methods are now being evaluated and are utilized in industry. The best method suitable for the inspection of monolithic structures is testing by ultrasonic transmission. Holographic interferometry appears to be a global method for the inspection of sandwich structures which can be applied to industrial use. Transl. by B.B.

N78-26479# Societe Nationale Industrielle Aerospatiale, Saint-Medard-en-Jalles (France).

NONDESTRUCTIVE INSPECTION OF COILED STRUCTURES AND THE RECEIPT OF RAW MATERIALS [CONTROLE NON-DESTRUCTIF DES STRUCTURES BOBINEES ET RECEPTION DES MATIERES PREMIERES]

Jean-Pierre Maigret *In* AGARD Non-destructive Inspection Relationships to Aircraft Design and Mater. Mar. 1978 13 p In FRENCH (For availability see N78-26460 17-38)
Avail: NTIS HC A15/MF A01

The reliability of coiled structures, especially those for solid rocket propellants is assured by the acceptance inspection of materials which rely on conventional mechanical tests associated with physical-chemical inspection (infrared microcalorimetry spectroscopy, etc) to verify the peremption level and the aging of organic materials, and by the two-phase nondestructive inspection of subassemblies and completed structures by thermography followed by ultrasonic and X-ray inspection to characterize the defects. Continuing efforts in inspection are directed towards enlarging the field of nondestructive methods by investigating the introduction of holography and acoustic analysis, and by improving physical-chemical techniques for better evaluation of the life of organic materials. Transl. by A.R.H.

N78-26480# Army Missile Research and Development Command, Redstone Arsenal, Ala. Advanced Systems Development and Manufacturing Technology Directorate.

DETECTION OF FLAWS IN METALLIC AND NON-METALLIC COMPOSITE STRUCTURES USING LIQUID CRYSTAL TECHNOLOGY

Shelba Profitt Brown *In* AGARD Non-destructive Inspection Relationships to Aircraft Design and Mater. Mar. 1978 14 p (For availability see N78-26460 17-38)
Avail: NTIS HC A15/MF A01

An experimental nondestructive test technique using brush-on liquid crystals and custom liquid crystal films is described. Application of the technique to metallic and nonmetallic composites is discussed along with demonstration of the technique on missile wings and elevons, aircraft and helicopter blades, composite body structures, and numerous types of electronic equipment. J.M.S.

N78-26261# General Motors Research Labs., Warren, Mich.

FINAL SURVEY OF STIRLING ENGINE COMPONENT DURABILITY

Raymond M. Cole *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 1.2: Model 3 Ground Power Units Design, Construc., and Testing, Gen. Motors Res. Studies Apr. 1978 26 p refs (For availability see N78-26250 17-31)
(GMR-2690-Sect-1.211) Avail: NTIS HC A12/MF A01

N78-26305# General Motors Research Labs., Warren, Mich.
SUMMARY OF RESULTS OF QUALITY CONTROL PROGRAM FOR MOLDING AND TESTING ROLLING SEALS
William H. Ahrens *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 4: Piston Rod Seals, 4.1 Sliding Seals, 4.2 Rolling Diaphragms Apr. 1978 13 p (For availability see N78-26299 17-31)
(GMR-2690-Sect-4.204) Avail: NTIS HC A12/MF A01

N78-26310# General Motors Research Labs., Warren, Mich.
SOME FACTORS IN ROLLING DIAPHRAGM SEAL LIFE
Dennis C. Kuzma *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 4: Piston Rod Seals, 4.1 Sliding Seals, 4.2 Rolling Diaphragms Apr. 1978 10 p refs (For availability see N78-26299 17-31)
(GMR-2690-Sect-4.209) Avail: NTIS HC A12/MF A01

N78-26311# General Motors Research Labs., Warren, Mich.
GPU-3 STIRLING ENGINE MAXIMUM COMPRESSION SPACE TEMPERATURE ENDURANCE TESTS. PART 2: ROLLING DIAPHRAGM SEALS
Ismail R. Hoyi *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 4: Piston Rod Seals, 4.1 Sliding Seals, 4.2 Rolling Diaphragms Apr. 1978 87 p refs (For availability see N78-26299 17-31)
(GMR-2690-Sect-4.210) Avail: NTIS HC A12/MF A01

N78-26313# General Motors Research Labs., Warren, Mich.
STIRLING ENGINE POWER PISTON SEAL TEST
Raymond M. Cole *In its* A Collection of Stirling Eng. Repts. from General Motors' Res., 1958 to 1970. Part 5: Piston Seals Apr. 1978 13 p (For availability see N78-26312 17-31)
(GMR-2690-Sect-5.001) Avail: NTIS HC A06/MF A01

N78-26332# General Motors Research Labs., Warren, Mich.
ANALYSIS OF THE FAILURE OF THE NICKEL TANK USED FOR LiOH THERMAL ENERGY STORAGE FOR THE CALVAIR AUTOMOBILE
John C. Bierlein *In its* A collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 7: Thermal Energy Storage and Publ. List, 7.1 Thermal Energy Storage, 7.2 List of Gen. Motors Stirling Eng. Publ. Apr. 1978 34 p ref (For availability see N78-26326 17-31)
(GMR-2690-Sect-7.106) Avail: NTIS HC A11/MF A01

39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance*.

N78-26481 Virginia Polytechnic Inst. and State Univ., Blacksburg.
RESPONSE OF PERIODIC STRUCTURES
Remi Carlos Engels 1977 177 p
Avail: Univ. Microfilms Order No. 7808116

Periodic structures are defined as structures consisting of identical substructures connected to each other in an identical manner. Their response to harmonic excitation was described by a matrix difference equation. The solution of the matrix difference equation was obtained by the Z-Transform method that yielded the responses to both end conditions and external excitations. Dissert. Abstr.

N78-26482 Texas Univ., Austin.
A GENERAL PROCEDURE FOR SUBSTRUCTURE COUPLING IN DYNAMIC ANALYSIS Ph.D. Thesis
Ching-Jone Chang 1977 141 p
Avail: Univ. Microfilms Order No. 7807276

A general procedure may be provided for analyzing complex and large structural systems that can be partitioned into substructures or components. Physical displacements are given in terms of generalized coordinates, which are the amplitudes of predetermined substructure coupling modes. The goal of this procedure for substructure coupling is to formulate the system equations of motion with reduced number of degrees of freedom, which can be solved to determine system response without significantly losing the accuracy. The various mode sets (normal modes, constraint modes, attachment modes and residual modes) are defined. A new method which employs residual attachment modes is presented in detail. Dissert. Abstr.

N78-26483 Pennsylvania State Univ., University Park.
FINITE ELEMENTS FOR VIBRATION ANALYSIS OF A BEAM Ph.D. Thesis
Dech Budcharoentong 1977 193 p
Avail: Univ. Microfilms Order No. 7808333

Two different approaches are suggested for the improvement of the accuracy of the finite element representation for dynamic analysis of a Bernoulli-Euler beam in the high frequency range. First, the concept of a generalized coordinate is used to generate a non-consistent, non-diagonal mass matrix. The non-consistent mass matrix is based on a quadratic displacement function. Also, an optimum non-consistent mass model is based upon matching of the natural frequencies of a four-segment clamped-free beam with the exact values of the uniform beam. The second approach is based on a mechanical impedance concept. An optimum three-parameter lumped mass model, is derived. General expressions for rates of convergence in natural frequencies are presented. Expressions for rate of convergence of element impedance are derived. The theoretical rates of convergence are confirmed by the numerical results of the various mass models. Dissert. Abstr.

N78-26484 Princeton Univ., N. J.
THE EFFECT OF IN-PLANE INITIAL STRESSES ON THE RESONANCES OF DOUBLY ROTATED CRYSTAL PLATES Ph.D. Thesis
Kuang-Ming Wu 1978 110 p
Avail: Univ. Microfilms Order No. 78-07511

By employing the system of six two-dimensional plate equations dispersion relations and frequency spectra for both monoclinic and triclinic crystal plates are obtained. Among the six coupled modes of vibrations, the thickness shear, flexural and extensional modes are chosen as the predominant incremental modes of vibrations for the study of frequency changes due to the initial stresses. The closed form solutions for the initial stress and strain fields are obtained. These fields are then taken into consideration in the coupled equations of incremental vibrations. Due to the non-uniformity of the initial fields and the smallness of the frequency changes, the perturbation method is used to calculate the changes in the frequencies. Dissert. Abstr.

N78-26485 Cornell Univ., Ithaca, N. Y.
TRANSIENT RESPONSE OF LAYERED ELASTIC SOLIDS TO UNIFORM PRESSURE ON A SPHERICAL CAVITY Ph.D. Thesis
Ralph Raymond Gajewski 1978 123 p
Avail: Univ. Microfilms Order No. 78-09486

The transient response of a layered elastic medium to impulsive pressure on the surface of an embedded spherical cavity is discussed. The spherical cavity of finite radius is treated as a transparent source so that the secondary interaction of waves reflected from the free surface and layer interfaces with the cavity region are neglected. The response of the medium to this source is found to be a convolution integral which is numerically evaluated. Previous analyses of finite cavity sources were restricted to the response of a half-space or a single layer due to the initial source compressional wave whereas this analysis includes the response due to all waves reflected and transmitted in the multilayered medium. Dissert. Abstr.

N78-26486 Brown Univ., Providence, R. I.
LARGE PLASTIC DEFORMATION AND INITIATION OF FRACTURE AT THE TIP OF A CRACK IN PLANE STRAIN Ph.D. Thesis

Robert Maxwell McMeeking 1977 200 p
Avail: Univ. Microfilms Order No. 7809076

Analyses of the stress and strain fields around smoothly blunting crack tips in elastic-plastic materials, under contained plane strain yielding, were carried out by a finite element method suitably formulated to admit large geometry changes. The results include the near tip deformation and stress fields. The hydrostatic stresses near the tip are limited due to lack of constraint, limiting achievable stress levels. Results of a number of other studies are reported. Dissert. Abstr.

N78-26487 Virginia Polytechnic Inst. and State Univ., Blacksburg.
NONLINEAR VIBRATIONS OF STRUCTURAL ELEMENTS SUBJECT TO MULTI-FREQUENCY EXCITATIONS Ph.D. Thesis
Zabihullah Mojaddidy 1977 113 p
Avail: Univ. Microfilms Order No. 78-07220

Relatively large-amplitude responses of structural elements subject to multi-frequency aperiodic excitations are studied. The governing equation of motion, which accounts for a weak cubic nonlinearity that is due to the stretching of the mid-plane, and linear viscous modal damping, are reduced to a set of second-order coupled nonlinear ordinary differential equations with constant coefficients. These equations which are of Duffing type are then solved by the perturbation method of Multiple Scales, and various resonances are studied with and without modal coupling (internal resonances). Of special interest, are simultaneious and combination external resonances. The study of these resonances emphasize the importance of accounting for all the forces present in a nonlinear vibrating system. Dissert. Abstr.

N78-26488 Texas Univ. at Austin.
THEORY OF FINITE ELEMENT APPROXIMATIONS OF A CLASS OF NONLINEAR BOUNDARY VALUE PROBLEMS IN FINITE ELASTICITY Ph.D. Thesis
Chandrupatla Tirupathi Reddy 1977 159 p
Avail: Univ. Microfilms Order No. 78-07371

A collection of inequalities useful in the approximation theory are developed for the operator associated with the plane elastostatics Dirichlet boundary value problem of a representative nonlinear hyperelastic material. The key inequalities involve the properties of boundedness, hemicontinuity and coercivity of the operator and the development of a Garding type inequality. Assumptions on the regularity of solutions are made, in order to establish the Garding inequality and to satisfy the invertibility condition. A priori estimates on the bounds of solutions, some properties of multiple solutions and some estimates when the data is dependent on a parameter are given. Properties of the linear operator, associated with the problem, are considered. A theorem on strong convergence of approximations is established for problems which yield a Garding type inequality. Finite element approximations are considered and error estimates are obtained for approximations of locally unique solutions of the model problem. Dissert. Abstr.

N78-26489 Cornell Univ., Ithaca, N. Y.
ARRIVAL TIME AND SPECTRAL ANALYSIS OF ELASTIC PULSES SCATTERED FROM TWO FLUIDFILLED CYLINDRICAL CAVITIES IN A SOLID Ph.D. Thesis
Selcuk Sancar 1977 285 p
Avail: Univ. Microfilms Order No. 78-07761

The scattering of wide-band ultrasonic pulses from two fluid-filled, side-drilled cylindrical cavities in an elastic solid are discussed. Various cavity sizes, spacings, and inclusion fluids are considered to determine the geometric and material influences on the sequence on scattered pulses. Measurements of the arrival times of the dominant signals are used to determine the dimensions, spacing, and orientation of the inclusions; and, for liquid inclusions, also the inclusion material wave speeds. Densities of the inclusion liquids are determined from the Fourier amplitudes of the scattered pulses. The power spectra of the signals are studied in detail. A solution for the scattering of plane harmonic waves from two such fluid filled cylindrical cavities is derived. Experimental backscattering spectra are obtained and compared with the theoretical results. Dissert. Abstr.

N78-26490 Brown Univ., Providence, R. I.
THE EFFECT OF STRAIN RATE AND STRAIN RATE HISTORY ON THE FLOW STRESS OF FOUR CLOSEPACKED METALS DEFORMED IN TORSION OVER A RANGE OF TEMPERATURES Ph.D. Thesis
Paul Edward Senseny 1977 77 p
Avail: Univ. Microfilms Order No. 78-09092

The influence of strain rate and strain rate history on the flow stress of several metals is presented. Experiments were performed on specimens of four polycrystalline metals: 1100-0 aluminum, OFHC copper, AZ31 B magnesium, and commercially pure zinc. The experiments involve the use of a modified Kolsky bar to increase abruptly the imposed strain rate, initially 0.0002/S, by a factor of more than 1,000,000. Tests were performed at selected temperatures in the range T less than or equal to 1/2 T sub M. The results include complete stress-strain curves for deformation at constant strain rates as well as for deformation involving a sharp increment in strain rate. The results are discussed in terms of microscopic mechanisms often associated with deformation and recovery. Dissert. Abstr.

N78-26491*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
STRESS-INTENSITY FACTORS FOR CORNER CRACKS AT THE EDGE OF A HOLE
I. S. Raju and J. C. Newman, Jr. Jun. 1978 35 p refs Presented at the 11th Natl. Symp. on Fracture Mech., Blacksburg, Va., 12-14 Jun. 1978
(NASA-TM-78728) Avail: NTIS HC A03/MF A01 CSCL 20K

Stress-intensity factors, calculated by a three-dimensional finite-element analysis, for shallow or deep quarter-elliptical corner cracks at the edge of a hole in a finite-thickness plate are presented. The plate was subjected to remote uniform tension, remote bending, or simulated pin loading in the hole. The crack depth-to-plate thickness ranged from 0.2 to 0.8, while the ratio of crack depth-to-plate crack length ranged from 0.2 to 2. The ratio of hole radius-to-plate thickness was held at 0.5. To verify the accuracy of the three-dimensional finite-element models empolyed, convergence studies were conducted (number of degrees of freedom ranged from 4400 to 9300). The stress-intensity factor variations along the crack front are presented and compared with other solutions from the literature. Author

N78-26492*# National Aeronautics and Space Administration, Washington, D. C.
ACCOMMODATING AND CRACKING MECHANISMS IN LOW-CYCLE FATIGUE
A. Pineau Jun. 1978 24 p refs Transl. into ENGLISH from Mec. Materiaux Elec. (France), no. 323-324, Nov. - Dec. 1976 p 6-14 Transl. by SCITRAN, Santa Barbara, Calif.
(Contract NASw-2791)
(NASA-TM-75227) Avail: NTIS HC A02/MF A01 CSCL 20K

The three main stages of fatigue life (accommodation, crack initiation and crack growth) are briefly reviewed. The cyclic behavior of annealed or predeformed face-centered cubic metals is described. Moreover, two types of alloys (Al-4-Cu and WASPALOY) are examined regarding the influence of the interactions between the precipitates and the dislocations on the cyclic behavior. Data on the percent of life to crack initiation (for a microcrack smaller than about 100 microns) are also given. Finally, experimental and theoretical results on crack growth rates in lowcycle fatigue are described. Author

N78-26493*# National Aeronautics and Space Administration, Washington, D. C.
CAN ACOUSTIC EMISSION DETECT THE INITIATION OF FATIGUE CRACKS: APPLICATION TO HIGH-STRENGTH LIGHT ALLOYS USED IN AERONAUTICS
C. Bathias, B. Brinet, and G. Sertour Jun. 1978 10 p refs Transl. into ENGLISH from Aeronaut. Astronaut. (Paris), no. 66, 1977 p 41-45 Original language document was announced as A78-15023 Transl. by Kanner (Leo) Associates, Redwood City, Calif. Original doc. prep. by Societe National Industriel Aerospatiale, Central Laboratory (Suresnes, France)
(Contract NASw-2790)
(NASA-TM-75306) Avail: NTIS HC A02/MF A01 CSCL 20K

Acoustic emission was used for the detection of fatigue cracking in a number of high-strength light alloys used in aeronautical structures. Among the features studied were: the influence of emission frequency, the effect of surface oxidation,

and the influence of grains. It was concluded that acoustic emission is an effective nondestructive technique for evaluating the initiation of fatigue cracking in such materials. Author

N78-26494*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
LIGHT AIRPLANE CRASH TESTS AT THREE FLIGHT-PATH ANGLES
Claude B. Castle and Emilio Alfaro-Bou Jun. 1978 69 p refs Films supplement number L-1247 to this report is available on request
(NASA-TP-1210; L-12060) Avail: NTIS HC A04/MF A01 CSCL 01C

Three similar twin engine general aviation airplane specimens were crash tested at Langley impact dynamics research facility at 27 m/sec and at flight-path angles of -15 deg, -30 deg, and -45 deg. Other flight parameters were held constant. The test facility, instrumentation, test specimens, and test method are briefly described. Structural damage and accelerometer data for each of the three impact conditions are presented and discussed. Author

N78-26495# Pennsylvania State Univ., University Park. Dept. of Engineering, Science and Mechanics.
SHOCK ANALYSIS OF TUBULAR VISCOPLASTIC BEAMS Final Report, 1 Jan. - 31 Dec. 1976
Stanley G. Gatchel and V. H. Neubert Jul. 1977 114 p refs (Contract N00014-75-C-0759)
(AD-A053185; FR-2) Avail: NTIS HC A06/MF A01 CSCL 13/13

An analytical method is outlined, and a related computer program Viscoplastic Beam Analysis (VPBA) is discussed, for prediction of response of a viscoplastic cantilever beam to ground shock. Some beams, which could be built using standard piping, are designed and analyzed using inputs typical of those on the floating shock barge. Author (GRA)

N78-26496# Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.
PLASTIC BUCKLING OF AXIALLY COMPRESSED CYLINDERS
A. K. Dhalla and L. H. Sobel Nov. 1977 89 p refs
(Contract EY-76-C-02-3045-032)
(WARD-SD-3045-9) Avail: NTIS HC A05/MF A01

Analytical and experimental results are presented for the problem of plastic buckling of axially compressed cylindrical shells. The cylinders are made from strain hardening materials and their geometries are in the range of interest encountered in the design of liquid metal fast breeder reactors vessels, heat exchangers, and piping systems. It was determined which one of a number of simple closed form formulas for the buckling load is reasonably accurate. The determination is based on a comparison of buckling loads predicted by the various formulas with those obtained from tests and from the more rigorous nonlinear buckling method of analysis. ERA

N78-26497# Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.
ANALYSIS OF TESTS ON AXIALLY COMPRESSED CYLINDERS
S. Z. Newman and L. H. Sobel Nov. 1977 34 p refs
(Contract EY-76-C-3045-032)
(WARD-SD-3045-8) Avail: NTIS HC A03/MF A01

Four axial compression room temperature tests on 8.9 cm outer diameter by 0.24 cm thick AISI 304 stainless steel cylinders are documented. The cylinders are loaded to buckling and beyond, and their deformation behavior is described. Two uniaxial tensile tests were performed on coupon specimens to determine material properties, and the results are given. The coupon specimens along with the four tested cylinders were cut from longer tubes, and they were all tested in the as-received condition. ERA

N78-26498# California Univ., Livermore. Lawrence Livermore Lab.
PRELIMINARY CHARACTERIZATION OF THE PRESSURE SUPPRESSION EXPERIMENT LOAD RESPONSE AND SOURCE ANALYSIS: AIR TEST SERIES
B. W. Davis 8 Aug. 1977 92 p refs
(Contract W-7405-eng-48)
(UCID-17552) Avail: NTIS HC A05/MF A01

Data from air tests conducted on the 1/5 scale model Mark 1 pressure suppression facility were analyzed for the purpose of determining the various sources of load signature characteristics. Hydrodynamic vertical loading function was shown to embody effects from: (1) momentum flux associated with flow from the downcomers; (2) momentum rate associated with bulk pool motion; and (3) unbalanced internal pressure forces related to phenomena associated with vent clearing. The integral form of the linear momentum equation is used to derive qualitative and quantitative insight into the mechanics of the hydrodynamic loading function. Amplitude spectra derived from Fouier transformations show that the 25 Hz (approximate) structural mode is the only frequency which appears consistently in all wave forms which were spectrum analyzed. ERA

N78-26499# Sandia Labs., Albuquerque, N. Mex.
INITIAL RESPONSE OF A ROCK PENETRATOR
Donald B. Longcope and D. E. Grady Dec. 1977 30 p refs (Contract EY-76-C-04-0789)
(SAND-77-1712) Avail: NTIS HC A03/MF A01

An analysis based on elastic rod theory is given for the earlytime axisymmetric response of pointed penetrators. Results of measurements by laser interferometry of the back surface particle velocity of laboratory scale penetrators impacted by sandstone targets are presented. Values of the initial pressure on the penetrator tip are determined which give agreement between the analytical and experimental results. These initial tip pressures are found to be approximated by the stress particle velocity Hugoniot for the target material. ERA

N78-26500# Instituto Nacional de Tecnica Aeroespacial, Esteban Terradas, Torrejon de Ardoz (Spain).
STATISTICAL ANALYSIS OF DATA OBTAINED FROM FINITE LIFE FATIGUE TESTING
Jose Maria PintadoFe and Manuel GarciaFernandez (IBERIA) 1977 14 p In SPANISH; ENGLISH summary Presented at the 4th Gen. Meeting of the Centro Nacl. de Invest. Met. (CENIM), Madrid, May - Jun. 1977
Avail: NTIS HC A02/MF A01

Data from finite life fatigue tests on steel and aluminum were statistically analyzed using the binomial and Weibull functions, and results were compared. It is shown that introduction of the actual value of the distribution curve shape parameter generally improves the result but does not insure the nonpersistence or occurrence, in some cases, of significant errors. ESA

N78-26501# Instituut TNO voor Werktuigkundige Constructies, Delft (Netherlands).
FATIGUE INVESTIGATIONS OF AEROFLEX SPRINGS TYPE CB 1380-40 [VERMOEIINGSONDERZOEK VAN AEROFLEX VEREN TYPE CB 1380-40]
A. J. Francken Dec. 1976 25 p refs In DUTCH; ENGLISH summary
(Contract A67/KM/028)
(IWECO-47450/6; TDCK-68864) Avail: NTIS HC A02/MF A01

Aeroflex isolators part number CB 1380-40 were fatigue tested in the three main directions by an accelerated procedure. Two isolators nominally loaded with a 50 kg man were subjected to random vibration. The spectrum in each direction contained the lowest natural frequency of the system in that direction. The test signal was quite similar to the vibration environment on board ship. The background of the test method is explained. Test results are compared with the endurance test requirements of MIL-STD-167-1 (ships). It is concluded that Aeroflex springs can be used without fatigue danger in ships which comply with MIL-STD167-1 (ships) sec. 5.1.3.3.3. Author (ESA)

N78-26502# Instituut TNO voor Werktuigkundige Constructies, Delft (Netherlands).
DETERMINATION OF THE STRESS CONCENTRATION FACTOR IN THE RADIUS OF A TEST BAR FOR THE INVESTIGATION ON GLASS FIBER REINFORCED POLYESTER [BEPALING VAN DE SPANNINGSCONCENTRATIEFACTOR IN DE AFRODING VAN EEN PROEFSTAAF VOOR HET ONDERZOEK AAN GLAS-

VEZEL VERSTERKT POLYESTER]
W. TenCate, R. Regoord, and P. Tegelaar May 1977 10 p In DUTCH; ENGLISH summary
(Contract A73/KM/106)
(IWECO-11244/4; TDCK-69502) Avail: NTIS HC A02/MF A01

The stress concentration factor in the circular part of an ISO 46% glass fiber reinforced polyester lamellon 4470, test bar with a radius of 6 times the width of the test bar, was found to be both theoretically (finite element method, ASKA computer program) and experimentally 1.07. The maximum deviation between calculation and experiment was 1.5%. This could be explained by the inhomogeneity of the glass fiber reinforced polyester material. ESA

N78-26503# Instituut TNO voor Werktuigkundige Constructies, Delft (Netherlands).
STABILITY ANALYSIS OF GLASS-REINFORCED POLYESTER STRUCTURES
H. Geertsema May 1977 44 p refs
(Contract A76/KM/047)
(IWECO-11965; TDCK-69503) Avail: NTIS HC A03/MF A01

The stability aspects of the main deck of glass-reinforced polyester ships was studied. The deck under consideration had three longitudinal stiffeners and several transverse stiffeners. At intervals of 9.000 mm the stiffened panel was supported by transverse frames, while longitudinal support was provided by the side hull of the ship. The geometry of the longitudinal and transverse stiffeners is given. The longitudinal stiffener was weakened at the intersection with a transverse stiffener, which affects the stiffness of the longitudinal stiffener and induces peak stresses near the cut-out. Author (ESA)

N78-26504# Royal Netherlands Aircraft Factories Fokker, Schiphol-Oost. Space Div.
LINEAR BUCKLING ANALYSIS WITH BOSOR 4
J. J. Wijker 8 Apr. 1977 35 p refs
(FOK-RV-77-28) Avail: NTIS HC A03/MF A01

A linear buckling load analysis was performed on the IRAS basic cone structure, which is assumed axisymmetric using the computer program BOSOR 4. With the selected parameter INDIC=4, linear bifurcation loads for axisymmetric structures, nonsymmetrically loaded were calculated. ESA

N78-26505# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.
FRACTURE MECHANICS APPLIED TO CREEP CRACKING
H. P. VanLeeuwen 15 Jul. 1977 56 p refs
(NLR-MP-77020-U) Avail: NTIS HC A04/MF A01

A review is made of creep cracking test results analyzed using various parameters such as the stress intensity factor, net section stress crack opening displacement and deformation energy rate. Theoretical prediction of creep crack growth rate on the basis of a conventional creep law is discussed. Creep crack growth due to vacancy diffusion and condensation is also considered. Author (ESA)

N78-26506# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.
EXTRAPOLATION OF CREEP TEST RESULTS ACCOUNTING FOR LONG TERM MATERIAL DEGRADATION
H. P. VanLeeuwen Sep. 1977 18 p refs Presented at Metals Properties Council/Elec. Power Res. Inst., Cleveland, 30-31 Aug. 1977
(NLR-MP-77021-U) Avail: NTIS HC A02/MF A01

A universal creep equation is shown to form the basis of a creep extrapolation method which accounts for long term material degradation but which makes use of separate parameters for creep and material degradation. ESA

N78-26507# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.
PRELIMINARY INVESTIGATION INTO THE APPLICATION OF MAGNETIC RUBBER INSPECTION (M.R.I.)
E. A. B. DeGraaf 12 Jan. 1978 15 p refs
(Contract RNLAF-RB-KLu-1976.C12)
(NLR-TR-76083-U) Avail: NTIS HC A02/MF A01

A brief description of the principles and probable advantages of the magnetic rubber inspection technique is given. The results of demonstration of the method are discussed and it is concluded that the method needs further evaluation. Author (ESA)

N78-26508# Transport and Road Research Lab., Crowthorne (England).
THE STRENGTH OF STIFFENED BOX GIRDER DIAPHRAGMS
R. S. Puthli and M. A. Crisfield 1977 34 p refs
(PB-277694/6; TRRL-SUPPLEMENTARY-353) Avail: NTIS HC A03/MF A01 CSCL 13B

A nonlinear finite element program was used to study the influence of design parameters and initial geometric imperfections on the strength of lightly stiffened steel box girder diaphragms. GRA

N78-26291# General Motors Research Labs., Warren, Mich.
A DERIVATION OF THE DESCRIBING EQUATIONS FOR A THIN ELASTIC SHELL OF REVOLUTION LOADED AXIALLY SYMMETRIC
Leland K. Shirley *In its* A Collection of Stirling Engine Reports from General Motors' Research, 1958 to 1970. Part 3: Stirling Engine Materials and Stresses, 3.1 Stirling Engine Materials, 3.2 Stirling Engine Stresses Apr. 1978 21 p (For availability see N78-26284 17-31)
(GMR-2690-Sect-3.201) Avail: NTIS HC A10/MF A01

N78-26292# General Motors Research Labs., Warren, Mich.
THE NUMERICAL INTEGRATION OF THE EQUATIONS WHICH DESCRIBE ELASTIC SHELLS
Leland K. Shirley *In its* A Collection of Stirling Engine Reports from General Motors' Research, 1958 to 1970. Part 3: Stirling Engine Materials and Stresses, 3.1 Stirling Engine Materials, 3.2 Stirling Engine Stresses Apr. 1978 18 p (For availability see N78-26284 17-31)
(GMR-2690-Sect-3.202) Avail: NTIS HC A10/MF A01

N78-26293# General Motors Research Labs., Warren, Mich.
STRESS ANALYSIS OF THE DISPLACER CYLINDER OF THE 10-36 STIRLING ENGINE
Leland K. Shirley *In its* A Collection of Stirling Engine Reports from General Motors' Research, 1958 to 1970. Part 3: Stirling Engine Materials and Stresses, 3.1 Stirling Engine Materials, 3.2 Stirling Engine Stresses Apr. 1978 23 p (For availability see N78-26284 17-31)
(GMR-2690-Sect-3.203) Avail: NTIS HC A10/MF A01

N78-26294# General Motors Research Labs., Warren, Mich.
EVALUATION OF STRESSES IN TUBES WITH EXTERNAL HEAT FLUX AND INTERNAL PRESSURIZATION
Wallace R. Wade *In its* A Collection of Stirling Engine Reports from General Motors' Research, 1958 to 1970. Part 3: Stirling Engine Materials and Stresses, 3.1 Stirling Engine Materials, 3.2 Stirling Engine Stresses Apr. 1978 19 p (For availability see N78-26284 17-31)
(GMR-2690-Sect-3.204) Avail: NTIS HC A10/MF A01

N78-26295# General Motors Research Labs., Warren, Mich.
AN INVESTIGATION OF STRESSES CAUSING DEFORMATION IN STIRLING ENGINE DISPLACER CYLINDERS
James E. Bennethum and Robbert Diepenhorst *In its* A Collection of Stirling Engine Reports from General Motors' Res., 1958 to 1970. Pt 3: Stirling Engine Materials and Stresses, 3.1 Stirling Engine Materials, 3.2 Stirling Engine Stresses Apr. 1978 29 p (For availability see N78-26284 17-31)
(GMR-2690-Sect-3.205) Avail: NTIS HC A10/MF A01

N78-26296# General Motors Research Labs., Warren, Mich.
A FINITE ELEMENT ANALYSIS OF STRESSES AND DEFORMATIONS IN STIRLING ENGINE DISPLACER CYLINDERS
Wallace R. Wade *In its* A Collection of Stirling Engine Reports from General Motors' Research, 1958 to 1970. Pt 3: Stirling Engine Materials and Stresses, 3.1 Stirling Engine Materials, 3.2 Stirling Engine Stresses Apr. 1978 45 p (For availability see N78-26284 17-31)
(GMR-2690-Sect-3.206) Avail: NTIS HC A10/MF A01

N78-26298# General Motors Research Labs., Warren, Mich.
BUCKLING OF STIRLING ENGINE COOLER ASSEMBLIES
John H. Lienesch *In its* A Collection of Stirling Engine Reports from General Motors' Res., 1958 to 1970. Pt 3: Stirling Engine Materials and Stresses, 3.1 Stirling Engine Materials, 3.2 Stirling Engine Stresses Apr. 1978 6 p (For availability see N78-26284 17-31)
(GMR-2690-Sect-3.208) Avail: NTIS HC A10/MF A01

42 GEOSCIENCES (GENERAL)

No abstracts in this category.

43 EARTH RESOURCES

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.
For instrumentation see *35 Instrumentation and Photography*.

N78-26509*# Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.
HEAT CAPACITY MAPPING MISSION Quarterly Progress Report, 1 Feb. - 30 Apr. 1978
Ray D. Jackson, Principal Investigator 30 Apr. 1978 3 p ERTS
(NASA Order S-40255B)
(E78-10139; NASA-CR-157173) Avail: NTIS HC A02/MF A01 CSCL 08H
There are no author-identified significant results in this report.

N78-26510*# National Oceanic and Atmospheric Administration, Washington, D. C.
APPLICATIONS OF HCMM DATA TO SOIL MOISTURE SNOW AND ESTUARINE CURRENT STUDIES Quarterly Report
Donald R. Wiesnet, Principal Investigator, David F. McGinnis, and Michael Matson 8 Jun. 1978 5 p Sponsored by NASA ERTS
(E78-10140; NASA-CR-157174; HCM-045; QR-3) Avail: NTIS HC A02/MF A01 CSCL 08C
There are no author-identified significant results in this report.

N78-26511*# College for Civil Engineering, Bucharest (Romania). Lab. for Remote Sensing.
USE OF LANDSAT DATA FOR NATURAL RESOURCES INVESTIGATION IN THE LOWER BASIN OF DANUBE AND DANUBE DELTA Final Report, May 1975 - Nov. 1976
Nicolaie OPrescu, Principal Investigator Sep. 1977 87 p refs Sponsored by NASA Original contains color imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S. D. 57198 ERTS
(E78-10141; NASA-CR-157175; DaDelta-1/6) Avail: NTIS HC A05/MF A01 CSCL 08F
The author has identified the following significant results. Monitoring of excess humidity was possible at the Baragan test site. Qualitative improvements of 20-50% were obtained in regards to soil inventory in the eastern Danube Delta, comparing data with conventional maps. The pedological situation was observed after drainage in impounded enclosures. The appearance of stagnate water was surveyed due to difference in color shades on LANDSAT imagery. Areas with gluey soils, such as lake bottoms rich in CaCO3 and shell grist, were clearly represented. Sediment discharges into the sea at the Danube mouth and plumes over 100 km at sea could be easily distinguished on LANDSAT MSS 4 and 5.

N78-26512*# Humboldt State Coll., Arcata, Calif. Center for Community Development.
DEVELOPING AND DEMONSTRATING AN INSTITUTIONAL MECHANISM FOR TRANSFERRING REMOTE SENSING TECHNOLOGY TO 14 WESTERN STATES USING NORTHERN CALIFORNIA AS THE TEST SITE Progress Report, 1 Jun. - 31 May 1978
Donna Hankins, Principal Investigator 31 May 1978 25 p refs Sponsored by NASA ERTS
(E78-10142; NASA-CR-157176; Rept-2) Avail: NTIS HC A02/MF A01 CSCL 05B
There are no author-identified significant results in this report.

N78-26513*# Minnesota Univ., Minneapolis. Space Science Center.
A STUDY OF MINNESOTA LAND AND WATER RESOURCES USING REMOTE SENSING Progress Report, 1 Jan. 1977 - 1 Jan. 1978
William G. Shepherd, Principal Investigator 31 Dec. 1977 269 p refs Original contains color imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S. D. 57198 ERTS
(Grant NGL-24-005-263)
(E78-10143; NASA-CR-157177) Avail: NTIS HC A12/MF A01 CSCL 05B
The author has identified the following significant results. Both LANDSAT imagery and digital data were studied for usefulness in surveying water conditions of Minnesota lakes. Initial consideration was given to analysis of LANDSAT image densities because of the low technologic and cost requirements. The techniques employed, however, yield inconsistent and unreliable results. A set of criteria is given for using LANDSAT data in identification of three categories of particulate contaminants in Lake Superior. A linear transformation giving the relationship between the residual LANDSAT intensities and concentrations of three contaminants was obtained from correlation of remote sensing data with insitu measurements. LANDSAT imagery was found useful in placing peat bogs and fens in their respective geologic settings. Artificial disturbances and drainageways in peatlands could be recognized and classified.

N78-26514*# Mitre Corp., McLean, Va. Metrek Div.
SIMPLIFIED MULTIPLE SCATTERING MODEL FOR RADIATIVE TRANSFER IN TURBID WATER
A. H. Ghovanlou and G. N. Gupta May 1978 72 p refs Sponsored by NASA
(Contract F19628-77-C-0001)
(NASA-CR-145365) Avail: NTIS HC A04/MF A01 CSCL 20N
Quantitative analytical procedures for relating selected water quality parameters to the characteristics of the backscattered signals, measured by remote sensors, require the solution of the radiative transport equation in turbid media. Presented is an approximate closed form solution of this equation and based on this solution, the remote sensing of sediments is discussed. The results are compared with other standard closed form solutions such as quasi-single scattering approximations. G.G.

N78-26515*# Old Dominion Systems, Inc., Gaithersburg, Md.
SIMULATION OF RADIOMETER DATA FROM A SPIN STABILIZED SATELLITE Final Report
S. Rangaswamy Oct. 1976 26 p refs
(Contract NAS5-22377)
(NASA-CR-156789) Avail: NTIS HC A03/MF A01 CSCL 04B
The effect of misregistration on cloud brightness threshold is investigated by simulating radiometric data as observed from a spin stabilized synchronous satellite such as the SMS. Clouds were introduced randomly and a bidirectional reflectance model was used to create radiance data from clouds and ocean. A theoretical and an empirical reflectance model were compared.
Author

N78-26516# Giddings (L. E., Jr.), Houston, Tex.
BOLIVIA FROM SPACE: IMAGES AND OTHER INFORMATION FROM SATELLITES, WITH CATALOGS
L. E. Giddings, Jr. Jan. 1977 275 p

(Giddings-77-01) Avail: NTIS HC A12/MF A01

Information about Bolivia is presented that was obtained from manned and unmanned satellites. A comprehensive catalog of photographs taken from the Gemini, Apollo, and Skylab manned missions is included. Information available from umanned satellites includes the LANDSAT earth resources technology satellites, the ITOS/NOAA polar orbiting meteorological satellites, and the SMS/GOES geosynchronous orbiting meteorological satellites. Some information on future satellites is also reported. Sample images of all types of data are included. G.G.

N78-26517# Oregon State Univ., Corvallis.

A RESEARCH STRATEGY FOR SOCIAL ASSESSMENT OF LAKE RESTORATION PROGRAMS

William D. Honey and Thomas C. Hogg Feb. 1978 53 p refs Sponsored by Environmental Research Lab., Corvallis

(PB-278347/0; EPA-600/5-78-004) Avail: NTIS HC A04/MF A01 CSCL 13B

The social implications of lake restoration programs and a standardized methodology for social impact assessment were developed. A cultural ecological model is employed since it provides perspectives on the relationship of human adaptation and cultural development in evolutionary terms. Use of the model calls for examination of both spatial and temporal parameters. GRA

N78-26518# Geological Survey, Harrisburg, Pa. Water Resources Div.

WATER RESOURCES DATA FOR PENNSYLVANIA, WATER YEAR 1976. VOLUME 2: SUSQUEHANNA AND POTOMAC RIVER BASINS Annual Report, 1 Oct. 1975 - 30 Sep. 1976

Sep. 1977 404 p

(PB-278754/7; USGS/WRD/HD-77/045-Vol-2; USGS/WDR/PA-76/2-Vol-2) Avail: NTIS HC A18/MF A01 CSCL 13B

Water resources data for the 1976 water year for Pennsylvania consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground water. Discharge records for 92 gaging stations; stage and contents for 10 lakes and reservoirs; water quality for 38 gaging stations, 15 partial-record stations, and water levels for 30 observation wells are included. Also included are 24 crest-stage partial-record stations and 46 low-flow partial-record stations. GRA

N78-26519# Louisiana State Univ. and A&M Coll., Baton Rouge. Coastal Studies Inst.

A NUMERICAL STUDY OF CURRENTS, WATER SURFACE ELEVATIONS, AND ENERGY DISSIPATION IN CHANDELEUR-BRETON SOUND, LOUISIANA Ph.D. Thesis

William E. Hart Feb. 1978 110 p refs

(Contract N00014-75-C-0192)

(AD-A053358; TR-250) Avail: NTIS HC A06/MF A01 CSCL 08/8

Numerical methods in the form of a digital computer model were used to simulate and study the tide- and wind-induced circulation in Chandeleur-Breton Sounds, which form a bar-built estuary southeast of New Orleans, Louisiana. The model output agreed very well with current observations taken over a 6 month period at 15 widely spaced stations in and around the estuary. The responses of the model estuary to average, tropic, and equatorial tides were studied in detail. It was found that the estuary exhibits low current speeds, on the order of 10-20 cm/sec, except in some of the shallow entrances through the Chandeleur Island chain, where speed reaches 50-60 cm/sec for short periods. Surface elevations were found to have an average tide range of 60 cm at the northwestern end of the estuary and to increase in range to 90 cm during tropic tides. The range in the sourthern part of the estuary was about 15 cm less at all times. It was also shown that the estuary responds directly to an applied wind force and that the expected set-up of the surface is in the downwind direction. GRA

N78-26520# Missouri Univ., Rolla. Missouri Water Resources Research Center.

MOBILITY OF HEAVY METAL HUMATES IN SOILS AND SURFACE WATERS Final Report

Ernst Bolter and Todd R. Butz Sep. 1977 56 p

(Contract DI-14-34-0001-6094)

(PB-278050/0; W78-04494) Avail: NTIS HC A04/MF A01 CSCL 13B

The dissolution of heavy metal compounds by humic acids and the formation of humic acid-metal complexes for copper, lead, zinc, and cadmium was investigated. The solubility of heavy metal compounds inc,reased sharply with humic acid compared to water with the same pH. The tendency to form humic acid complexes increased in the sequence cadmium, zinc, lead and copper. The tendency to form complexes increased with increasing humic acid concentration and higher pH, but decreased with increasing electrolyte content of the solution. Runoff samples from a heavily polluted smelter area were in agreement with the laboratory data. GRA

N78-26521# Northern Arizona Univ., Flagstaff. School of Forestry.

LAKE AND PAN EVAPORATION VALUES FOR NORTHERN ARIZONA Final Report

Charles C. Avery Nov. 1977 84 p

(Contracts DI-14-34-0001-7005; DI-14-34-0001-7006)

(PB-277820/7; W78-04101; OWRT-A-062-ARIZ(1)) Avail: NTIS HC A05/MF A01 CSCL 13B

Site-specific water resource problems in northern Arizona were investigated. Specifically, the project has: (1) contributed to the development of a hydrologic and economic analysis of the feasibility of lining Upper Lake Mary; (2) searched out and analyzed historic records of pan evaporation for northern Arizona; (3) maintained a Class A evaporation station at Lake Mary, Coconino County, Arizona for three summers; (4) mapped the surface configuration bottom relief of Ashurst Lake, Coconino County, Arizona, and determined the depth-area-volume relationships; (5) made a preliminary assessment of the water balance of Ashurst Lake; and (6) provided some basic geologic data for Upper Lake Mary. GRA

N78-26522# California Univ., Livermore. Lawrence Livermore Lab.

AUTOMATION OF THE NATIONAL WATER QUALITY LABORATORIES, US GEOLOGICAL SURVEY. 1: DESCRIPTION OF LABORATORY FUNCTIONS AND DEFINITION OF THE AUTOMATION PROJECT

W. F. Morris and H. S. Ames 1 Jul. 1977 277 p refs

(Contract W-7405-eng-48)

(UCRL-52295-Pt-1) Avail: NTIS HC A13/MF A01

Because the present system for processing water samples was found inadequate to meet the demands of a steadily increasing workload, new automation was recommended. Details necessary for future implementation of the new system are reported, as well as descriptions of current laboratory automatic data processing and analytical facilities to better define the scope of the project and illustrate what the new system will accomplish. All pertinent inputs, outputs, and other operations that define the project are shown in functional designs. ERA

N78-26523# Los Alamos Scientific Lab., N. Mex.

GMAPS USER'S MANUAL

Mona J. Wecksung, Richard J. Wiley, and A. Keith Turner (Colorado Energy Res. Inst., Golden) Jan. 1978 50 p

(Contract W-7405-eng-36)

(LA-6975-M) Avail: NTIS HC A03/MF A01

Land use planners involved in siting analyses must make complex decisions based on their in-depth knowledge of numerous factors. These factors include resource location, accessibility to transportation corridors, and legal, social, and environmental constraints. The General Map Analyses Planning System (GMAPS) is a composite computer mapping system designed to assist the planning team in making these decisions rapidly and efficiently. GMAPS allows the user to define a series of different scenarios and to investigate quickly a wide range of planning alternatives. It is a remote access interactive system that can be operated by nontechnical personnel from portable terminals at field offices. ERA

N78-26524# Oak Ridge National Lab., Tenn.

NATIONWIDE ASSESSMENT OF WATER QUANTITY IMPACTS OF THE NATIONAL ENERGY PLAN.

VOLUME 1: SUMMARY AND CONCLUSIONS
Jerome E. Dobson, Alf D. Shepherd, Ronald G. Palmer (Los Alamos Sci. Lab. N. Mex.), and Shen-yann Chiu Dec. 1977 69 p refs
(Contract W-7405-eng-26)
(ORNL/TM-6098-Vol-1; ORNL/OEPA-3-Vol-1) Avail: NTIS HC A04/MF A01

The water requirements of steam electric generating plants, coal liquefaction and gasification facilities, and coal extraction activities projected for 1985 are calculated, and impacts associated with the National Energy Plan (NEP) Intiative are compared with those of a Base Case Scenario for the conterminous United States. It can be concluded that there is no appreciable difference in water quantity impacts at the Water Resources Council aggregated subarea level. Consumption as a percentage of the surface supply never varies by more than one percent between the two scenarios except for the Trinity Basin of Texas, and most of the differences are reductions from the base case to the NEP. However, for either case there will be a considerable increase in water use for energy between 1975 and 1985, and water availability may constrain development in several basins of the western United States. Even in the humid eastern United States localized water problems may occur on certain small tributaries. ERA

N78-26525# Department of Energy, Bartlesville, Okla. Bartlesville Energy Research Center.
REVIEW OF PETROLEUM OIL SATURATION AND ITS DETERMINATION
E. C. Donaldson and Michael E. Crocker Dec. 1977 48 p refs
(BERC/RI-77/15) Avail: NTIS HC A03/MF A01

The influence of the wettability of the rock-oil-water system on the microscopic structure of oil saturation is discussed from a background of experimental work conducted at BERC as well as a review of the literature. The general conclusion is that the wetting phase occupies the small pores and coats the surface of the larger pores. A summary of the gross distribution of oil saturation that remains at the end of waterfloods using various well patterns is presented and the methods of laboratory analysis of cores obtained from oilfields are discussed. Core analysis is capable of measuring the distribution of oil saturation in a reservoir, but it is too costly and time-consuming to be applied to a complete field; therefore, its results are complemented by well logs to achieve an economical evaluation of oil saturation. In addition, brief explanations of the procedures and utility of various well logging techniques are presented. ERA

N78-26526# California Univ., Berkeley. Lawrence Berkeley Lab.
INTERACTIVE DISPLAY OF POLYGONAL DATA Computer Science and Applied Mathematics Dept.
P. M. Wood Oct. 1977 37 p refs
(Contract W-7405-eng-48)
(LBL-6490; Conf-7710100-1) Avail: NTIS HC A03/MF A01

The interactive thematic mapping system called CARTE, combines polygonal base maps with statistical data to produce shaded maps using a variety of shading symbolisms on a variety of output devices. A polygonal base map is one where geographic entities are described by points, lines, or polygons. It is combined with geocoded data to produce special subject or thematic maps. Shading symbolisms include texture shading for areas, varying widths for lines, and scaled symbols for points. Output devices include refresh and storage CRTs and auxiliary Calcomp or COM hardcopy. The system is designed to aid in the quick display of spatial data and in detailed map design. GRA

N78-26527# National Aerospace Lab., Amsterdam (Netherlands). Scientific Services.
IMAGE DATA SECURITY IN THE CONCEPT OF THE AGRICULTURAL REAL TIME IMAGING SATELLITE SYSTEM (ARTISS)
H. A. VanIngenSchenau, L. J. M. Joosten, and J. L. Simons 28 Apr. 1976 117 p refs
(Contract NIVR-1798)
(NLR-TR-76010-U) Avail: NTIS HC A06/MF A01

Under consideration was the requirement for exclusive access to satellite imagery in the concept of ARTISS. Security assessment indicates that user survey requests are handled confidentially and shows the access vulnerability of the transmission of image data to the user groundstation. To ensure the security of this transmission two promising methods are available. Directional transmission using a directive spacecraft antenna, supported by an onboard jamming transmitter which causes deterioration of the picture quality outside a trusted territory; and crypto technique, achieved through onboard enciphering of the image data and deciphering at the user groundstation. Implementation costs for directional transmission and crypto technique are 6% and 3% of the ARTISS costs, respectively. In the case of crypto technique, a 20% cost increase for operations is expected.
Author (ESA)

N78-26528# Deutsches Geodaetisches Forschungsinstitut, Munich (West Germany).
VARIATION OF THE AERIAL PHOTOGRAPHIC ARRANGEMENT. ITS INFLUENCE ON THE MEAN ADJUSTMENT IN THE PRESENCE OF RANDOM AND SYSTEMATIC IMAGE FAILURES Ph.D. Thesis - Bonn Univ. [VARIATION DER BILDFLUGANORDNUNG. IHRE AUSWIRKUNG AUF DIE BUENDELAUSGLEICHUNG BEI VORLIEGEN ZUFAELLIGER UND SYSTEMATISCHER BILDFEHLER]
Joachim Thomas Bayerische Akad. der Wiss. 1977 133 p refs In GERMAN
(Ser-C/Diss-233; ISBN-3-7696-9289-6) Avail: NTIS HC A07/MF A01

Failure theory relations in aerial photography for the application of block adjustment according to the least squares method are discussed. Topics include the influence of normal distributed random image failures, systematic image failures, and mixed failures on the beam adjustment and compensation of systematic failures by the aerial photographic arrangement. ESA

N78-26529# Cameron Engineers, Inc., Denver, Colo.
OIL SHALE RESEARCH OVERVIEW
Charles O. Hook May 1977 79 p
(Contract EPA-68-01-4337)
(PB-278159/9; EPA-908/4-77-007) Avail: NTIS HC A05/MF A01 CSCL 08I

A compilation is given of some federally sponsored oil shale research, both current and recently completed. A breakdown of funding levels and number of projects in the areas of (1) general environmental research, (2) water research, (3) atmospheric research, (4) land and revegetation research, (5) health effects research, and (6) miscellaneous oil shale research is shown.
GRA

N78-26530# North Central Forest Experiment Station, St. Paul, Minn.
GROUND WATER DIFFERENCES ON PINE AND HARDWOOD FORESTS OF THE UDELL EXPERIMENTAL FOREST IN MICHIGAN Final Forest Service Research Paper
2 Feb. 1978 15 p refs
(PB-278309/0; FSRP-NC-145) Avail: NTIS HC A02/MF A01 CSCL 08H

Ground water recharge under hardwood and pine forest was measured from 1962 to 1971 on the Udell Experimental Forest in Michigan. Hardwood forests produced more net ground water than pine forests by an average of 50 and 100 mm/year, using two methods of analysis. Shallow water table lands yield 80 to 100 mm/year less water than deep, well drained sands. Water yield decreased the most between drainage classifications of pine plantations. GRA

N78-26531# Guam Univ., Agana. Water Resources Research Center.
GROUNDWATER ANALYSIS BY TRITIUM TECHNIQUE: A PRELIMINARY EVALUATION
John F. Mink and L. Stephen Lau Oct. 1977 39 p refs
(Contracts DI-14-34-0091-6054; DI-14-34-0001-7023)
(PB-277806/6; TR-2; W78-04100; OWRT-A-002-GUAM(1))
Avail: NTIS HC A03/MF A01 CSCL 08H

Water samples representing basal, parabasal, basal spring, and perched water in limestone in northern Guam and volcanic groundwater in southern Guam were collected, analyzed, evaluated, and interpreted in terms of tritium and selected geochemical water quality parameters in 1976. The groundwater

age was very young, about 5 or less years old, and readily rechargeable by contemporary rain water. There was a discernable gradation in the tritium level and chemical quality of the water samples. GRA

N78-26532# Geological Survey, Menlo Park, Calif. Water Resources Div.
DIGITAL-MODEL EVALUATION OF THE GROUND-WATER RESOURCES IN THE OCOTILLO-COYOTE WELLS BASIN, IMPERIAL COUNTY, CALIFORNIA Final Report
James A. Skrivan Nov. 1977 56 p refs Prepared in cooperation with Imperial County Dept. of Public Works, El Centro, Calif.
(PB-277533/6; USGS-WRD-WRI-78-012; USGS-WRI-77-30) Avail: NTIS HC A04/MF A01 CSCL 08H

A flow model using finite-element techniques has been constructed for an alluvial aquifer in the Ocotillo-Coyote Wells basin. Natural recharge is about 2,600 acre-feet per year, and estimated ground water in storage is 640,000 acre-feet. Pumpage totaled 880 acre-feet in 1975. The computed decline from steady-state conditions in 1925 to December 1975 was 15 feet in Ocotillo. The projected decline from 1976 to 1995 with annual pumpage of 1,000 acre-feet is 6 feet and with annual pumpage of 2,000 acre-feet is 17 feet in Ocotillo. In the latter projection, continued pumping after 1995 may cause saline water to flow toward the potable ground water in and around Ocotillo. GRA

N78-26533# Arizona Univ., Tucson. Dept. of Geosciences.
EVALUATION OF GROUNDWATER RESERVES IN THE SANTA CRUZ VALLEY AREA, PIMA AND SANTA CRUZ COUNTIES, ARIZONA
John S. Summer Jan. 1978 7 p refs
(Contracts DI-14-34-0001-7005; DI-14-34-0001-7006; OWRT Proj. A-078-ARIZ(1))
(PB-278372/8; W78-04819) Avail: NTIS HC A02/MF A01 CSCL 13B

The gravity method of geophysical exploration was used to determine the groundwater potential in the upper Santa Cruz Valley, in Santa Cruz County, Arizona. GRA

N78-26534# Geological Survey, Okemos, Mich. Water Resources Div.
WATER RESOURCES DATA FOR MICHIGAN, WATER YEAR 1976 Annual Report, 1 Oct. 1975 - 30 Sep. 1976
Jun. 1977 628 p refs
(PB-277942/9; USGS/WRD/HD-77/033; USGS/WDR/MI-76/1) Avail: NTIS HC A99/MF A01 CSCL 08H

Water resources data for the 1976 water year for Michigan consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels in wells. Discharge records for 194 gaging stations; stage and contents for 5 lakes and reservoirs; water quality for 75 continuous record stations, 28 partial-record stations and 5 lakes; and water levels for 27 observations wells are contained. Also included are 33 low-flow partial-record stations. GRA

N78-26535# Geological Survey, Boise, Idaho. Water Resources Div.
WATER RESOURCES DATA FOR IDAHO, WATER YEAR 1976 Annual Report, 1 Oct. 1975 - 30 Sep. 1976
Nov. 1977 649 p refs
(PB-278017/9; USGS/WRD/HD-77/054; USGS/WDR/ID-76/1) Avail: NTIS HC A99/MF A01 CSCL 13B

Water resources data for the 1976 water year for Idaho consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground water. Discharge records for 192 gaging stations; stage only records for 2 gaging stations; stage for 6 lakes; contents for 25 lakes and reservoirs; water quality for 91 gaging stations, 42 partial-record stations, 2 lakes, and 222 wells; and water levels for 6 observation wells are included. Also included are data for 58 crest-stage partial-record stations and 180 low-flow partial-records stations. GRA

N78-26536# Geological Survey, Albuquerque, N. Mex.
WATER RESOURCES DATA FOR NEW MEXICO, WATER YEAR 1976
Nov. 1977 666 p
(PB-277922/1; USGS/WDR/NM-76/1; USGS/WRD/JD-77/048) Avail: NTIS HC A99/MF A01 CSCL 08H

Water resources data for the 1976 water year for New Mexico consist of records of discharge and water quality of streams; stage, contents and water quality of lakes and reservoirs; and water levels and water quality in wells and springs. Discharge records for 212 gaging stations; stage and contents for 24 lakes and reservoirs; water quality for 67 gaging stations, 19 partial-record stations, 1 reservoir, 8 springs and 205 wells; and water levels for 98 observation wells are included. Also included are 155 crest-stage partial-record stations and 2 low-flow partial-record stations. GRA

N78-26537# Geological Survey, Salt Lake City, Utah. Water Resources Div.
WATER RESOURCES DATA FOR UTAH, WATER YEAR 1976 Annual Report, 1 Oct. 1975 - 30 Sep. 1976
Aug. 1977 634 p
(PB-277927/0; USGS/WRD/HD-77/001-046; USGS/WRD/UT-76/1) Avail: NTIS HC A99/MF A01 CSCL 08H

Water resources data for the 1976 water year for Utah consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels and water quality of ground water. Discharge records for 240 gaging stations; stage and contents for 21 lakes and reservoirs; water quality for 42 hydrologic stations, 123 partial-record stations, and 387 wells; and water levels for 152 observation wells are included. GRA

N78-26538# National Technical Information Service, Springfield, Va.
STREAM EROSION AND SCOURING PROCESSES. A BIBLIOGRAPHY WITH ABSTRACTS Progress Report, 1964 - May 1978
Robena J. Brown May 1978 119 p Supersedes NTIS/PS-77/0437; NTIS/PS-76/0381
(NTIS/PS-78/0436/2; NTIS/PS-77/0437; NTIS/PS-76/0381) Avail: NTIS HC $28.00/MF $28.00 CSCL 08H

Studies on erosion and scouring processes and actions of rivers and streams are cited. Erosion of stream banks, bridge supports, levees, and other hydraulic structures are covered. (This updated bibliography contains 111 abstracts, 15 of which are new entries to the previous edition.) GRA

N78-26539# Missouri Univ., Rolla. Center for Missouri Water Resources Research.
HYDROGEOLOGY AND DELINEATION OF BURIED GLACIAL RIVER VALLEY AQUIFERS IN NORTHWESTERN MISSOURI
John M. Sharp, Jr., Russell F. Burmester, and Olav Malvik 1 Dec. 1977 72 p refs
(Contracts DI-14-34-0001-7053; DI-14-34-0001-7054)
(PB-278035/1; OWRT-A-097-MO(1)) Avail: NTIS HC A04/MF A01 CSCL 08G

Northwestern Missouri possesses a network of buried glacial or preglacial river valley aquifers. These aquifers represent the major groundwater resource in an otherwise relatively water poor area. Bedrock formations contain saline water of over 1000 ppm total dissolved solids. A multiple geophysical exploration program (involving gravity, seismic and electrical methods) was designed to delineate these aquifers. A gravity grid reconnaissance was made in the selected field area, and gravity residuals determined by polynomial trend surface analysis. Some success was achieved in finding shallow aquifers. The multiple geophysical method appears feasible in northwestern Missouri, whereas any approach by itself is insufficient. A proposed ground-water exploration program is outlined. GRA

44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells and batteries; global sources of energy; fossil fuels; geophysical conversion; hydroelectric power; and wind power.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *85 Urban Technology and Transportation.*

N78-26540*+ National Aeronautics and Space Administration, Washington, D. C.
ENERGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES, SUPPLEMENT 16, JANUARY 1978
Jan. 1978 773 p
(NASA-SP-7043(16)) Avail: NTIS HC E05 CSCL 10B

This bibliography lists 1287 reports, articles, and other documents introduced into the NASA scientific and technical information system from October 1, 1977 through December 31, 1977. Author

N78-26541*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LOW-COST SILICON SOLAR ARRAY PROJECT ENVIRONMENTAL HAIL MODEL FOR ASSESSING RISK TO SOLAR COLLECTORS
Charles Gonzalez 6 Dec. 1977 54 p refs Sponsored by DOE
(Contract NAS7-100)
(NASA-CR-157225; JPL-5101-45) Avail: NTIS HC A04/MF A01 CSCL 10A

The probability of solar arrays being struck by hailstones of various sizes as a function of geographic location and service life was assessed. The study complements parallel studies of solar array sensitivity to hail damage, the final objective being an estimate of the most cost effective level for solar array hail protection. Author

N78-26542*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TRANSIENT RESPONSE TO THREE-PHASE FAULTS ON A WIND TURBINE GENERATOR Ph.D. Thesis - Toledo Univ.
Leonard J. Gilbert Jun. 1978 146 p refs
(NASA-TM-78902; E-9638) Avail: NTIS HC A07/MF A01 CSCL 10A

In order to obtain a measure of its responses to short circuits a large horizontal axis wind turbine generator was modeled and its performance was simulated on a digital computer. Simulation of short circuit faults on the synchronous alternator of a wind turbine generator, without resort to the classical assumptions generally made for that analysis, indicates that maximum clearing times for the system tied to an infinite bus are longer than the typical clearing times for equivalent capacity conventional machines. Also, maximum clearing times are independent of tower shadow and wind shear. Variation of circuit conditions produce the modifications in the transient response predicted by analysis. P.R.A.

N78-26543*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STATUS OF WRAPAROUND CONTACT SOLAR CELLS AND ARRAYS
Cosmo R. Baraona and L. E. Young 1978 10 p refs Proposed for presentation at the 13th Intersociety Energy Conversion Engr. Conf., San Diego, Calif., 20-25 Aug. 1978; sponsored by SAE, ACS, AIAA, ASME, IEEE, AICHE, and ANS
(NASA-TM-78911; E-9646) Avail: NTIS HC A02/MF A01 CSCL 10A

Solar cells with wraparound contacts provide the following advantages in array assembly: (1) eliminate the need for discretely formed, damage susceptible series tabs; (2) eliminate the n gap problem by allowing the use of uniform covers over the entire cell surface; (3) allow a higher packing factor by reducing the additional series spacing formly required for forming, and routing the series tab; and (4) allow the cell bonding to the interconnect system to be a single-side function wherein series contacts can be made at the same time parallel contracts are made. Author

N78-26544*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PRELIMINARY EVALUATION OF GLASS RESIN MATERIALS FOR SOLAR CELL COVER USE
Stanley J. Marsik, Clifford K. Swartz, and Cosmo R. Baraona Jun. 1978 7 p refs Presented at 13th Photovoltaic Specialists Conf., Washington, D. C., 5-8 Jun. 1978; sponsored by IEEE
(NASA-TM-78925; E-9665) Avail: NTIS HC A02/MF A01 CSCL 10A

The glass resins were deposited by several techniques on 200 micron thick cells and on 50 microns thick wafers. The covered cells were exposed to ultraviolet light in vacuum to an intensity of 10 UV energy-equivalent solar constants at air mass zero for 728 hr. The exposure was followed by a single long thermal cycle from ambient temperature to -150 C. Visual inspection of the samples indicated that all samples had darkened to varying degrees. The loss in short-circuit current was found to range from 8 to 24%, depending on the resin formulation. In another test over 40 glass resin-coated silicon wafers withstood 15 thermal cycles from 100 to-196 C in one or more of the thicknesses tested. Several of the resin-coated wafers were tested at 65 C and 90% relative humidity for 170 hr. No change in physical appearance was detected. Author

N78-26545*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ULTRAVIOLET IRRADIATION AT ELEVATED TEMPERATURES AND THERMAL CYCLING IN VACUUM OF FEP-A COVERED SILICON SOLAR CELLS
J. D. Broder and S. J. Marsik 1978 8 p refs Presented at the 13th Photovoltaic Specialists Conf., Washington, D. C., 5-8 Jun. 1978; sponsored by IEEE
(NASA-TM-78926; E-9666) Avail: NTIS HC A02/MF A01 CSCL 10A

Experiments were designed and performed on silicon solar cells covered with heat-bonded FEP-A in an effort to explain the rapid degeneration of open-circuit voltage and maximum power observered on cells of this type included in an experiment on the ATS-6 spacecraft. Solar cells were exposed to ultraviolet light in vacuum at temperatures ranging from 30 to 105 C. The samples were then subjected to thermal cycling from 130 to -130 C. Inspection following irradiation indicated that all the covers remained physically intact. However, during the temperature cycling heat-bonded covers showed cracking. The test showed that heat-bonded FEP-A covers embrittle during UV exposure and the embrittlement is dependent upon sample temperature during irradiation. The results of the experiment suggest a probable mechanism for the degradation of the FEP-A cells on ATS-6. Author

N78-26546*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AN IMPROVED TECHNIQUE FOR THE CALIBRATION OF SOLAR CELLS USING A HIGH ALTITUDE AIRCRAFT
Earle O. Boyer Apr. 1978 13 p refs
(NASA-TM-78871; E-9603) Avail: NTIS HC A02/MF A01 CSCL 10A

A description of a technique for the airborne calibration of solar cells is given. Aircraft modifications and data supporting the inherent advantages of the techniques are discussed. Author

N78-26547*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
VARIATION OF SOLAR CELL SENSITIVITY AND SOLAR RADIATION ON TILTED SURFACES
Thomas M. Klucher 1978 10 p refs Presented at the 13th Photovoltaic Specialists Conf., Washington, D. C., 5-8 Jun. 1978; sponsored by IEEE
(Contract E(49-26)-1022)
(NASA-TM-78921; DOE/NASA/1022-78/32; E-9661) Avail: NTIS HC A02/MF A01 CSCL 10A

The validity is studied that one of various insolation models used to compute solar radiation incident on tilted surfaces from global data measured on horizontal surfaces. The variation of solar cell sensitivity to solar radiation is determined over a wide

range of atmospheric condition. A new model was formulated that reduced the deviations between measured and predicted insolation to less than 3 percent. Evaluation of solar cell sensitivity data indicates small change (2-3 percent) in sensitivity from winter to summer for tilted cells. The feasibility of using such global data as a means for calibrating terrestrial solar cells is discussed. G.G.

N78-26548*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

ENDURANCE TESTING OF FIRST GENERATION (BLOCK 1) COMMERCIAL SOLAR CELL MODULES

E. Anagnostou and Americo F. Forestieri 1978 9 p ref Presented at the 13th Photovoltaic Specialists Conf., Washington, D. C., 5-8 Jun. 1978; sponsored by IEEE

(Contract E(49-26)-1022)

(NASA-TM-78922; DOE/NASA/1022-78/33; E-9662) Avail: NTIS HC A02/MF A01 CSCL 10A

To determine lifetimes of the first generation (Block 1) commercial solar cell modules used in solar cell arrays, a program was initiated to expose these modules to a range of environments. The conditions endured by these modules encompassed hot and dry, hot and humid, tropical rain forests, sea-air, urban industrial and urban clean. Exposures were for periods up to 1 year. The effect of outdoor exposure on the performance of the modules was determined using current-voltage curves. Short-circuit current (I sub sc) and maximum power (P sub max) were the parameters monitored. In all cases, there was a loss of performance of the modules with outdoor exposure. Author

N78-26549*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

DOE LeRC PHOTOVOLTAIC SYSTEMS TEST FACILITY

Ronald C. Cull and Americo F. Forestieri 1978 10 p refs Presented at the 13th Photovoltaic Specialists Conf., 5-8 Jun. 1978; sponsored by IEEE

(Contract E(49-26)-1022)

(NASA-TM-78923; DOE/NASA/1022-78/34; E-9663) Avail: NTIS HC A02/MF A01 CSCL 10A

The facility was designed and built and is being operated as a national facility to serve the needs of the entire DOE National Photovoltaic Program. The object of the facility is to provide a place where photovoltaic systems may be assembled and electrically configured, without specific physical configuration, for operation and testing to evaluate their performance and characteristics. The facility as a breadboard system allows investigation of operational characteristics and checkout of components, subsystems and systems before they are mounted in field experiments or demonstrations. The facility as currently configured consist of 10 kW of solar arrays built from modules, two inverter test stations, a battery storage system, interface with local load and the utility grid, and instrumentation and control necessary to make a fexible operating facility. Expansion to 30 kW is planned for 1978. Test results and operating experience are summaried to show the variety of work that can be done with this facility. G.Y.

N78-26550*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

IMPACT OF BALANCE OF SYSTEM (BOS) COSTS ON PHOTOVOLTAIC POWER SYSTEMS

Gerald F. Hein, James P. Cusick, and William A. Poley 1978 8 p Presented at the 13th Photovoltaic Specialists Conf., Washington, D. C., 5-8 Jun. 1978; sponsored by IEEE

(Contract E(49-26)-1022)

(NASA-TM-78939; DOE/NASA/1022-78/40; E-9685) Avail: NTIS HC A02/MF A01 CSCL 10A

The Department of Energy has developed a program to effect a large reduction in the price of photovoltaic modules, with significant progress already achieved toward the 1986 goal of 50 cents/watt (1975 dollars). Remaining elements of a P/V power system (structure, battery storage, regulation, control, and wiring) are also significant cost items. The costs of these remaining elements are commonly referred to as Balance-of-System (BOS) costs. The BOS costs are less well defined and documented than module costs. The Lewis Research Center (LeRC) in 1976/77 and with two village power experiments that will be installed in 1978. The costs were divided into five categories and analyzed. A regression analysis was performed to determine correlations of BOS Costs per peak watt, with power size for these photovoltaic systems. The statistical relationship may be used for flat-plate, DC systems ranging from 100 to 4,000 peak watts. A survey of suppliers was conducted for comparison with the predicted BOS cost relationship. Author

N78-26551*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

BASELINE TESTS OF THE KORDESH HYBRID PASSENGER VEHICLE

Richard F. Soltis, John M. Bozek, Robert J. Denington, and Miles O. Dustin Jun. 1978 69 p

(Contract EC-77-A-31-1011)

(NASA-TM-73769; CONS-1011-14; E-9604) Avail: NTIS HC A04/MF A01 CSCL 10A

Performance test results are presented for a four-passenger Austin A40 sedan that was converted to a heat-engine-alternator- and battery-powered hybrid. It is propelled by a conventional, gasoline-fueled, heat-engine-driven alternator and a traction pack powering a series-wound, 10 hp direct-current electric drive motor. The 16 hp gasoline engine drives the 7 kilowatt alternator, which provides electrical power to the drive motor or to the 96 volt traction battery through a rectifier. The propulsion battery consists of eight 12 volt batteries connected in series. The electric motor is coupled to a four-speed standard transmission, which drives the rear wheels. Power to the motor is controlled by a three-step foot throttle, which actuates relays that control armature current and field excitation. Conventional hydraulic brakes are used. G.G.

N78-26552*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

DESIGN AND OPERATING EXPERIENCE ON THE US DEPARTMENT OF ENERGY EXPERIMENTAL MOD-0 100-kW WIND TURBINE

John C. Glasgow and Arthur G. Birchenough 1978 17 p refs Proposed for presentation at the 13th Intersoc. Energy Conversion Eng. Conf., San Diego, Calif., 20-25 Aug. 1978

(Contract E(49-26)-1028)

(NASA-TM-78915; E-9652; DOE/NASA/1028-78/18) Avail: NTIS HC A02/MF A01 CSCL 10A

The experimental wind turbine was designed and fabricated to assess technology requirements and engineering problems of large wind turbines. The machine has demonstrated successful operation in all of its design modes and served as a prototype developmental test bed for the Mod-0A operational wind turbines which are currently used on utility networks. The mechanical and control system are described as they evolved in operational tests and some of the experience with various systems in the downwind rotor configurations are elaborated. G.G.

N78-26553*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

DOE/NASA MOD-0A WIND TURBINE PERFORMANCE

T. R. Richards and H. E. Neustadter 1978 8 p refs Proposed for presentation at the 13th Intersoc. Energy Conversion Eng. Conf., San Diego, Calif., 20-25 Aug. 1978

(Contract E(49-26)-1004)

(NASA-TM-78916; E-9654; DOE/NASA/1004-78/13) Avail: NTIS HC A02/MF A01 CSCL 10A

Design and operation of a large wind turbine at Clayton, New Mexico is reported. This is the first of three identical 200 kW wind turbines to be operated on electric utility networks. A comparison between its predicted and measured power versus wind speed performance is presented. G.G.

N78-26554*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

DESCRIPTION AND STATUS OF NASA-LERC/DOE PHOTOVOLTAIC APPLICATIONS SYSTEMS

Anthony F. Ratajczak 1978 10 p refs Presented at the 13th Photovoltaic Specialists Conf., Washington, D. C., 5-8 Jun. 1978; sponsored by IEEE

(Contract E(49-26)-1022)

(NASA-TM-78936; E-9679; DOE/NASA/1022-78/38) Avail: NTIS HC A02/MF A01 CSCL 10A

Designed, fabricated and installed were 16 geographically

dispersed photovoltaic systems. These systems are powering a refrigerator, highway warning sign, forest lookout towers, remote weather stations, a water chiller at a visitor center, and insect survey traps. Each of these systems is described in terms of load requirements, solar array and battery size, and instrumentation and controls. Operational experience is described and present status is given for each system. The P/V power systems have proven to be highly reliable with almost no problems with modules and very few problems overall. Author

N78-26555*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DESIGN AND FABRICATION OF A PHOTOVOLTAIC POWER SYSTEM FOR THE PAPAGO INDIAN VILLAGE OF SCHUCHULI (GUNSIGHT), ARIZONA
William J. Bifano, Anthony F. Ratajczak, and William J. Ice 1978 10 p Presented at the 13th Photovoltaic Specialists Conf., Washington, D. C., 5-8 Jun. 1978; sponsored by the IEEE
(Contract E(49-26)-1022)
(NASA-TM-78948; E-9672; DOE/NASA/1022-78/39) Avail: NTIS HC A02/MF A01 CSCL 10A

A stand alone photovoltaic power system for installation in the Papago Indian village of Schuchuli is being designed and fabricated to provide electricity for village water pumping and basic domestic needs. The system will consist of a 3.5 kW (peak) photovoltaic array; controls, instrumentations, and storage batteries located in an electrical equipment building and a 120 volt dc village distribution network. The system will power a 2 HP dc electric motor. Author

N78-26556*# General Electric Co., Philadelphia, Pa. Space Div.
SOLAR HEATING AND COOLING SYSTEM DESIGN AND DEVELOPMENT Quarterly Summary, Jan. - Mar. 1978
Apr. 1978 33 p Prepared for DOE
(Contract NAS8-32092)
(NASA-CR-150705) Avail: NTIS HC A03/MF A01 CSCL 10A

The progress made in the manufacture, test, evaluation, installation, problem resolution, performance evaluation, and development of eight prototype solar heating and combined heating and cooling systems is described. M.V.

N78-26557*# Northrup, Inc., Hutchins, Tex.
DEVELOPMENT AND FABRICATION OF A CONCENTRATING SOLAR COLLECTOR SUBSYSTEM Quarterly Report, 1 Jan. - 31 Mar. 1977
Apr. 1977 37 p Prepared for DOE
(Contract NAS8-32251)
(NASA-CR-150712; QR-2) Avail: NTIS HC A03/MF A01 CSCL 10A

The progress of work on the evacuated receiver, lens design, lens die fabrication, and improvements on components, production techniques, and performance testing is discussed. M.V.

N78-26558*# Northrup, Inc., Hutchins, Tex.
DEVELOPMENT AND FABRICATION OF A CONCENTRATING SOLAR COLLECTOR SUBSYSTEM Quarterly Report, 1 Apr. 1977 - 30 Sept. 1977
(Contract NAS8-32251)
(NASA-CR-150713; QR-3; QR-4) Avail: NTIS HC A12/MF A01 CSCL 10A

The finalization of designs, fabrication of the new lens, receiver, and tracking box and a review of the contract status are presented. Author

N78-26559*# Northrup, Inc., Hutchins, Tex.
CONCENTRATING SOLAR COLLECTOR SUBSYSTEM: PRELIMINARY DESIGN PACKAGE Quarterly Report, 1 Oct. - 31 Dec. 1976
20 Jan. 1977 109 p Prepared for DOE
(Contract NAS8-32251)
(NASA-CR-150714; Rept-10046-4; QR-1) Avail: NTIS HC A06/MF A01 CSCL 10A

Preliminary design data are presented for a concentrating solar collector including an attitude controller. Provided are schedules, technical status, all documents required for preliminary design, and other program activities. G.G.

N78-26560# Aerospace Corp., El Segundo, Calif. Chemistry and Physics Lab.
IMPEDANCE MEASUREMENTS ON SEALED LEAD-ACID CELLS
M. R. Martinelli and A. H. Zimmerman 10 May 1978 25 p refs
(ATR-78(8114)-1) Avail: NTIS HC A02/MF A01 CSCL 10C

The impedance of sealed 2.5 ampere hour lead-acid cells was measured as a function of state of charge at frequencies of 10 Hz to 500 KHz. The impedance of a small lead-acid wet cell employing flat plate electrodes was also measured over this frequency range. Comparisons between the results for these two cell types indicated that impedances were sensitive to chemical and physical changes which accompanied cell discharge. A model is proposed which relates inductive behavior for porous electrodes to the electrode structure. Double layer capacities are estimated for the two types of lead-acid cells. J.A.M.

N78-26561# Sydney Univ. (Australia). Dept. of Aeronautical Engineering.
THE THEORETICAL PERFORMANCE OF A STRAIGHT-BLADED, VERTICAL AXIS WIND TURBINE
T. A. Thomson Jan. 1978 42 p refs
(ATN-7802) Avail: NTIS HC A03/MF A01

Equations predicting the performance, under unstalled operating conditions of the blading, of straight-bladed, vertical axis wind turbine rotors are derived analytically. Performance characteristics of rotors of this type are evaluated and discussed. Author

N78-26562# Sandia Labs., Albuquerque, N. Mex.
PROGRAM CYCLE: A RANKINE CYCLE ANALYSIS ROUTINE
J. P. Abbin and W. R. Leuenberger Oct. 1977 78 p refs Sponsored by DOE
(SAND-74-0099-Rev) Avail: NTIS HC A05/MF A01

The computer program CYCLE which models and analyzes various Rankin cycle systems including supercritical cycles with or without regeneration and subcritical cycles with or without regeneration and/or super heat is described. The program accommodates a variety of working fluids and generates the required thermodynamic properties internally using a modest number of input constants. The program version presented is written in FORTRAN 4 in a conversational mode suitable for timesharing. J.M.S.

N78-26563# Sandia Labs., Livermore, Calif.
EFFECTIVENESS OF SPECTRALLY SELECTIVE SURFACES FOR EXPOSED, HIGH-TEMPERATURE SOLAR ABSORBERS
M. Abrams Jan. 1978 30 p refs
(Contract EY-76-C-04-0789)
(SAND-77-8300) Avail: NTIS HC A03/MF A01

A theoretical heat transfer analysis of spectrally selective absorbers shows that spectral selectivity offers the greatest benefits for conditions of high absorber temperature and/or low values of solar irradiation. By using a two-band model of the selective absorber, the cutoff wavelength which maximizes absorber efficiency was found to depend on just two parameters: the absorber temperature, and the level of solar irradiation. The emittance of the infrared band has a greater effect upon efficiency than the absorptance of the solar band when a critical dimensionless parameter exceeds unity. The analysis was undertaken for application to central receivers for solar tower focus power plants. ERA

N78-26564# Sandia Labs., Albuquerque, N. Mex.
LASER RAY TRACE AND BI-DIRECTIONAL REFLECTOMETRY MEASUREMENTS OF VARIOUS SOLAR CONCENTRATORS Presented at the Concentrating Solar Collector Conf., Atlanta, 26 Sep. 1977
R. B. Pettit and B. L. Butler 1977 19 p refs
(Contract EY-76-C-04-0789)
(SAND-77-1466C; Conf-770953-4) Avail: NTIS HC A02/MF A01

In order to characterize the optical quality of reflecting parabolic solar concentrators, low measurement techniques were developed. Laser ray trace measurements were used to

determine the focal length and focused beam size of the parabolic structures, while bidirectional reflectometry was developed to measure the specular reflectance properties of mirror materials. The overall optical quality of a concentrator is calculated by combining results from these two measurements. Model parabolic structures were fabricated by commercial suppliers from a variety of materials, including forest products, metals, ceramics and plastics. ERA

N78-26565# Honeywell, Inc., Minneapolis, Minn. Systems and Research Center.
OPTIMIZATION OF COATINGS FOR FLAT PLATE SOLAR COLLECTORS, PHASE 2 Final Report, 28 Jun. 1976 - 27 Jun. 1977
R. J. H. Lin and P. B. Zimmer Jul. 1977 133 p refs
(Contract EY-76-C-02-2930)
(COO-2930-12) Avail: NTIS HC A07/MF A01

Optical coatings that would enhance the economic feasibility of flat plate solar collectors were investigated. Etched and dipcoated antireflection (AR) coatings and selective absorbing plated and paint coatings that are low cost and optically efficient were investigated. A selective paint coating was developed with solar absorptance of 0.92 and room temperature emittance of 0.10. It was made through the optimization of coating thickness, pigment volume concentration, and pigment particle size. Accelerated humidity and outdoor exposure tests were conducted for black chrome, black-nickel and black iron coatings. The black chrome coating is most durable and its life was estimated to be greater than 30 years. ERA

N78-26566# General Electric Co., Philadelphia, Pa. Space Div.
ANALYSIS OF DESIGN CHANGES NECESSARY TO ADAPT RECEIVER TO COMPOUND PARABOLIC REFLECTOR Final Report
R. Bingman Sep. 1977 72 p refs
(Contract W-31-109-eng-38)
(ANL-K-3805-1) Avail: NTIS HC A04/MF A01

An optimization study for the coupling of vacuum tube receivers to compound parabolic reflectors to produce an efficient, cost effective collector concept capable of operating in the 200 to 400 F range is presented. The thermal analysis study is described, a working fluids survey and recommendations are discussed, and an evaluation of the vacuum tube coating is included. Prototype hardware for test verification is described. ERA

N78-26567# Los Alamos Scientific Lab., N. Mex.
IMPACTS OF THE NATIONAL ENERGY PROGRAMME ON SOLAR ECONOMICS
S. Ben-David, S. Noll, F. Roach, and W. Schulze 1978 70 p Presented at the Intern. Solar Energy Congr. New Delhi, 16 Jan. 1978
(Contract W-7405-eng-36)
(LA-UR-78-131; Conf-780114-2) Avail: NTIS HC A04/MF A01

The National Energy Plan (NEP) sets as a goal the use of solar energy in two and a half million homes in 1985. A key provision of the NEP (as well as congressional alternatives) provides for the subsidization of solar equipment. The extent to which these subsidies (income tax credits) might offset the impact of continued energy-price control is examined. Regional prices and available of conventional energy sources (oil, gas, and electricity) were compiled to obtain a current and consistent set of energy prices by state and energy type. Projections of conventional fuel price increase (or decreases) are made under both the NEP scenario and a projected scenario where all wellhead price controls are removed on natural gas and crude oil production. The economic feasibility (life cycle cost basis) of solar energy for residential space heating and domestic hot water is examined on a state-by-state basis. ERA

N78-26568# George Washington Univ., Washington, D. C. School of Engineering and Applied Science.
SUMMARY OF PROCEEDINGS OF SOLAR HEATING AND COOLING COMMERCIALIZATION WORKSHOP
R. H. Bezdek, A. B. Cambel, and C. R. Hauer May 1977 48 p Workshop held at Washington, D.C., 4-5 May 1977
(Contract EG-77-C-01-4017)
(DSE/4017-1) Avail: NTIS HC A03/MF A01

The present state of commercialization of solar heating and cooling was examined and suggestions were obtained from the various parties of interest on how the existing commercialization process might be improved. The discussions were limited to the existing government program and near term program changes which could increase the growth rate of solar energy heating and cooling. A four session workshop was conducted in which the following general areas were covered: (1) the industrial perspective; (2) legal issues; (3) the utility interface; and (4) institutional considerations. ERA

N78-26569# Department of Energy, Bartlesville, Okla. Energy Research Center.
STIRLING ENGINE: AN OPTION FOR UNDERGROUND MINES
W. F. Marshall Mar. 1978 8 p
(BERC/RI-78/3) Avail: NTIS HC A02/MF A01

The use of heat engines for powering mobile equipment in underground mines offers advantages over electric power in terms of mobility and electric shock hazards. However, exhaust is discharged into the working environment; thus, there is a potential hazard associated with toxic combustion products. Although diesel engines are in use in underground mines, other heat engines might be considered for use because of potentially lower emission rates. The Stirling engine is a possible alternative to the diesel because it shows promise as a low emission, high power density engine. In order to assess the potential of the Stirling for mining applications, performance data are required. To fill this need, data on the composition of the exhaust from a Stirling engine were obtained. The results indicate that the Stirling engine compares very favorably with low emission diesels with respect to emissions characteristics. ERA

N78-26570# Charles River Associates, Inc., Cambridge, Mass.
METHODOLOGY FOR PREDICTING THE DEMAND FOR NEW ELECTRICITY USING GOODS Final Report
Dec. 1977 81 p refs
(EPRI Proj. 488-1)
(EPRI-EA-593) Avail: NTIS HC A05/MF A01

A model was exposited to analyze conventional demand functions. The potential and requirements for applying this model to the market for home-temperature-conditioning alternatives are considered to predict the future demand for heat pumps with specified characteristics. The applicability of the model to studying the demand for heat pumps is discussed, and the specifics of such a study are illustrated. ERA

N78-26571# Argonne National Lab., Ill. Chemical Engineering Div.
ADVANCED FUEL CELL DEVELOPMENT Progress Report, Jul. - Sep. 1977
J. P. Ackerman, K. Kinoshita, J. W. Sim, R. Swaroop, and P. A. Nelson Nov. 1977 27 p refs
(Contract W-31-109-eng-38)
(ANL-77-79) Avail: NTIS HC A03/MF A01

Fuel cell research and development activities are presented. Work was aimed at understanding and improving the performance of fuel cells having molten alkali-carbonate mixtures as electrolytes; the fuel cells operate at temperatures near 923 K. Effort was directed toward development of methods for fabricating and evaluating electrolyte structures for these cells and optimizing their design. Cell performance, life, and cost are the criteria of optimization. A clear relationship was established between electrolyte structure and cell performance, and the effectiveness of a wet-seal protection technique was demonstrated for more than 2600 h. A method for testing of electrolyte specimens for thermal expansion and high-temperature static creep was developed. Results for the first few samples are given, and a tentative preliminary correlation with conventional creep behavior is proposed. ERA

N78-26572# National Academy of Sciences - National Research Council, Washington, D. C. Ad Hoc Panel on Liquefaction of Coal.
ASSESSMENT OF TECHNOLOGY FOR THE LIQUEFACTION OF COAL: SUMMARY

Dec. 1977 45 p
(Contract EX-76-C-01-1216)
(FE-1216-2) Avail: NTIS HC A03/MF A01

Scale-up of the most promising solvent extraction process and the most promising direct catalytic coal-oil-slurry hydrogenation process (H-Coal) is carried forward expeditiously at a scale of 250 to 600 tons per day. ERA

N78-26573# Department of Energy, Washington, D. C.
FOSSIL ENERGY DEMONSTRATION PLANTS
Nov. 1977 16 p
(TID-28182) Avail: NTIS HC A02/MF A01

The conversion of domestic coal resources into environmentally and socially acceptable substitutes for oil and natural gas is considered. In processing fossil fuels, the plant size needed for acceptable economics is very large. Capital requirements are, therefore, large and the time from conceptual design to capacity operation and process evaluation is long. The need for demonstration plant as an intermediate step between the pilot plant and the commercial plant is outlined. The program encourages private industry to become industrial partners who direct project and share the risks and costs of demonstrating unproven but potentially viable fossil energy conversion and utilization technologies. The industrial partner directs all design, construction and operation. Demonstration plant projects in the program areas of fuel gas and pipeline gas are described. ERA

N78-26574# Lockheed Missiles and Space Co., Palo Alto, Calif. Metallurgy and Composites Lab.
THERMODYNAMIC PHASE STABILITY DIAGRAMS FOR THE ANALYSIS OF CORROSION REACTIONS IN COAL GASIFICATION/COMBUSTION ATMOSPHERES
P. L. Hemmings and Roger A. Perkins Dec. 1977 110 p refs
(EPRI Proj. 716-1)
(EPRI-FP-539) Avail: NTIS HC A06/MF A01

An understanding of corrosion chemistry in complex environments is needed for the effective use of metals and alloys in coal gasification/combustion systems. High-temperature corrosion reactions were analyzed from a thermodynamic equilibrium point of view. The equilibrium pressure of sulfur, oxygen, nitrogen and carbon in the gas will determine which condensed phases can stand in equilbrium with the gas. Reaction paths can be charted to determine how other phases can exist beneath the surface scale. The use of thermodynamic phase-stability diagrams for this purpose is discussed. The diagrams show which phases can exist at a given temperature for a given element (Fe, Ni, Co, etc.) in a mixture of two different oxidants (C,O,S, and N). The derivation and use of these diagrams to interpret behavior in coal gasification/combustion atmospheres is discussed. ERA

N78-26575# California Univ., Livermore. Lawrence Livermore Lab.
LLL GAS STIMULATION PROGRAM Quarterly Progress Report, Jul. - Sep. 1977
M. E. Hanson, R. J. Shaffer, G. D. Anderson, H. C. Heard, D. O. Emerson, C. Knutson (Geoenergy Corp.), and B. C. Haimson (Wisconsin Univ., Madison) 28 Oct. 1977 40 p refs
(Contract W-7405-eng-48)
(UCRL-50036-77-3) Avail: NTIS HC A03/MF A01

Two theoretical models that simulate, respectively, the local and distance effects of the hydraulic fracturing process were formulated. Application and analysis have indicated that for a penetrating fluid the stress intensity factor tends to decrease as the pore pressure increases. Laboratory fracturing experiments the hydraulic fluid pressure necessary to initiate a crack is relatively insensitive to the applied load on the block. The sensitivity of the principal stress magnitudes on the fracture orientation was also tested. A rock geometry and mechanics study of the Western tight gas sands was also completed. ERA

N78-26576# General Atomic Co., San Diego, Calif.
PREDICTION OF THERMOELECTRIC BATTERY POWER AND VOLTAGE FOR A 15 YEAR LIFETIME MB-75 mW (B) BATTERY
E. J. Steeger and J. C. Bass Nov. 1977 16 p ref
(Contract EY-76-C-03-0167-060; Proj. 3246)
(GA-A-14718) Avail: NTIS HC A02/MF A01

In order to predict the power output of a radioisotope-powered thermoelectric generator (RTG) at sometime in the future, it is necessary to make corrections for both isotope decay and for module degradation. The laws governing isotope decay are well known, however, their application to a RTG can be complicated by other phenomena which occurs within the generator. Results of an empirical approach to the problem are presented. ERA

N78-26577# Department of Energy, Grand Forks, N. Dak.
DESIGN AND OPERATION OF TWO REFRACTORY-LINER, INTERNALLY HEATED, ENTRAINED-BED CARBONIZERS
Charles C. Boley and M. M. Fegley [1977] 42 p refs
(GFERC/RI-77/1) Avail: NTIS HC A03/MF A01

Coals, from lignite to high-volatile A bituminous in rank, were successfully carbonized in two similar internally-heated entrained-bed carbonization units. Operating temperatures were from 825 F to 1600 F, and extended runs of up to 106 hours were made. Effects of coal particle size, reactor length, coal and air rates, operating temperature, coal rank, and coal condition (full moisture or dried) on carbonizer operation and yields are discussed. Comparisons with earlier results with an alloy-steel carbonizer using an external heat source are also made. ERA

N78-26578# National Academy of Sciences - National Research Council, Washington, D. C. Commission on Sociotechnical Systems.
ASSESSMENT OF ADVANCED TECHNOLOGY FOR DIRECT COMBUSTION OF COAL
Dec. 1977 100 p refs
(Contracts EX-76-C-01-1216; E(49-18)-1216)
(HCP/T1216-0001) Avail: NTIS HC A05/MF A01

Methods were assessed for burning high-sulfur coal that would permit existing sulfur dioxide, nitrogen oxides, and particulate emission limits to be met without a substantial increase in capital investment or in operating costs and that would improve the thermal efficiency of the electric-power generation process. Fluidized-bed combustion of coal has the potential for controlling gaseous emissions more econmically than existing methods. Of all the alternative processes considered the most promising for first-stage development is atmospheric pressure fluidized-bed combustion using a minimum amount of excess air and a carbon burnup cell to complete combustion. Fluidized-bed combustion may be available for industrial boilers and total energy systems in the early 1980s. The larger, more complex units needed for electric-power generation require additional demonstration. ERA

N78-26579*# Thermo Electron Engineering Corp., Waltham, Mass.
ERDA-NASA ADVANCED THERMIONIC TECHNOLOGY PROGRAM Program Report
Aug. 1977 16 p refs
(Contracts NAS3-20959; EY-76-C-02-3056)
(NASA-CR-157222; PR-26; TE-4220/4233-29-78;
COO-3056-28) Avail: NTIS HC A02/MF A01 CSCL 10B

Research is summarized on surface studies (work functions of different LaB6 surfaces), plasma studies, converter development (tungsten emitter, nickel collector and tungsten emitter La B6 collector), and hot shell development for using thermionic converters in the topping cycle of fossil-fuel plants.Author (ERA)

N78-26580# California Univ., Livermore. Lawrence Livermore Lab.
SUMMARY OF THE METAL-AIR FUEL CELL RESEARCH PROGRAM
J. F. Cooper 8 Sep. 1977 13 p refs
(Contract W-7405-eng-48)
(UCID-17591) Avail: NTIS HC A02/MF A01

An analysis was conducted to determine whether a full performance, economical electric vehicle can be developed using a mechanically rechargeable metal -- air battery as a power source. State of the art and projected performance, energy conversion efficiency, estimates of cost of ownership and operation, considerations of market entry, and current research areas are discussed. Li, Al, and Ca seem to hold the greatest promise. ERA

N78-26581# Mississippi State Univ., Mississippi State. Energy Research Center.
TESTING AND EVALUATION OF MHD MATERIALS AND

SUBSTRUCTURES Quarterly Technical Progress Report, Jan. - Mar. 1977
Oct. 1977 56 p refs
(Contract EX-76-C-01-2246)
(FE-2246-3-Rev-A) Avail: NTIS HC A04/MF A01

The equilibrium chemical composition and constituent phases of the gas stream were determined as a function of temperature. These calculations allow determination of the initial stream preparation conditions of the MSU test stand at 1.1 atm that will match the operating conditions of the baseline MHD plant. The longitudinal variation of the total wall heat flux, gas temperature, gas velocity, metal surface temperature on both the gas side and water side, and slag thickness were determined for various cases of slag coated and bare wall conditions using the developed thermal model of the metallic materials component test stand and annular boiler. P.R.A.

N78-26582# Public Service Electric and Gas Co., Newark, N. J.
ECONOMIC ASSESSMENT OF THE UTILIZATION OF LEAD-ACID BATTERIES IN ELECTRIC UTILITY SYSTEMS Final Report
A. C. Johnson, Jeffrey A. Hynds, David R. Nevius, Gerald A. Nunan, and Neale Sweetman Nov. 1977 203 p
(Contract EX-76-C-02-2857)
(HCP/T2857-1) Avail: NTIS HC A10/MF A01

Particular attention is given to searching the PSE and G system for installations of batteries which could defer or cancel costly transmission and/or distribution projects. Although the transmission and distribution data are based on specific applications on the PSE and G system, the generation data are based on a national reference system. Data on lead-acid battery costs and characteristics were provided by ERDA. The report analyzes and summarizes all costs and savings attributable to lead-acid batteries. The general approach used is to first identify specific applications for the PSE and G transmission and distribution system. The amounts and required characteristics of lead-acid batteries to satify the needs of the transmission applications are determined. ERA

N78-26583# Los Alamos Scientific Lab., N. Mex.
STATUS OF EUROPEAN THERMOCHEMICAL HYDROGEN PROGRAMS
M. G. Bowman 16 Nov. 1977 5 p Presented at the DOE Ann. Chem. Energy Storage and Hydrogen Energy Systems Contract Rev. Meeting, Washington, D.C., 16-17 Nov. 1977
(Contract W-7405-eng-36)
(LA-UR-77-2985; Conf-771131-3) Avail: NTIS HC A02/MF A01

Visits were made to European Laboratories engaged in thermochemical hydrogen research. The vists to the listed laboratories were primarily to learn the scope of the different programs and the general areas of information expected to made available under the International Energy Agency Implementing Agreement on the Production of Hydrogen from Water. From observations made during the visits, the following conclusions were reached: (1) It is clear that Europeans are directing their efforts towards relatively short term development of better methods for the production and utilization of hydrogen. (2) The European effort on thermochemical hydrogen research and development is significantly greater than the total of U.S. programs. (3) It will advantageous for the United States to cooperate in infromation exchange activities under the I.E.A. The description of the different visits is given in the format of a trip report. ERA

N78-26584# Oak Ridge National Lab., Tenn.
VALUE OF ENERGY STORAGE FOR DIRECT-REPLACEMENT SOLAR THERMAL POWER PLANTS
T. D. Anderson, Stephen I. Kaplan, and John V. Wilson 1978 29 p refs Presented at the Appl. Workshop: Thermal Storage Integrated into Solar Power Plants, SERI, Golden, Colo., 14-15 Feb. 1978
(Contract W-7405-eng-26)
(CONF-780216-2) Avail: NTIS HC A03/MF A01

The general objective of the study was to develop information on energy storage requirements for solar thermal power plants as an aid to planning and implementing the research and development work. The specific objectives of the study are to derive cost targets for energy storage systems over a range of applications of direct-replacement solar-thermal power plants and to determine the amount of energy storage required for a given cost of storage. The utility applications considered are base-load (100% demand factor) and intermediate-load (50% and 25% demand factor). Locations examined are Inyokern, Chicago, and Philadelphia. The locations selected are intended to provide a representative sampling of U.S. conditions with respect to both solar resources and utility system load patterns. Backup capacity, economic tradeoffs, demand factors, and economic analysis are discussed. It is concluded that the energy storage R and D program should focus on storage systems of relatively low capacity, i.e., less than 6 kW/hr/kW. ERA

N78-26585# Oak Ridge National Lab., Tenn. Environmental Sciences Div.
ENERGY FROM BIOMASS: AN OVERVIEW OF ENVIRONMENTAL ASPECTS
R. D. Roop 1978 15 p refs Presented at Technol. for Energy Conserv., Albuquerque, N. Mex., 23 Jan. 1978
(Contract W-7405-eng-48)
(CONF-780109-3) Avail: NTIS HC A02/MF A01

Recent literature regarding energy from biomass is reviewed in order to delineate environmental issues and suggest research needed for assessment of this energy option. Potential sources of biomass for conversion to energy include agricultural and forestry residues, municipal and industrial wastes, biomass plantations, and freshwater and marine grown plant material. The impacts of using wastes and of growing biomass for fuel are summarized. ERA

N78-26586# Oregon Univ., Eugene. Solar Energy Center.
COMMUNITY LEADERS WORKSHOP ON SOLAR ENERGY ASSESSMENT Final Report
C. Venolia, ed. Aug. 1977 45 p Workshop held in Eugene, Ore., 20 Aug. 1977
(Contract EY-76-S-06-2230-005)
(RLO/2230/T5-1) Avail: NTIS HC A03/MF A01

A summary of activities and discussions and general format of a solar energy conference at Eugene, Oregon, to involve local groups in the assessment of environmental and social issues relating to solar energy development are presented. The topics of the three workshops were (1) solar heating and cooling, (2) fuels from biomass, and (3) agricultural and industrial heat. ERA

N78-26587# California Univ., Berkeley. Lawrence Berkeley Lab. Dept. of Chemical Engineering.
CELLULOSE, FOOD AND ENERGY
C. R. Wilke Nov. 1977 44 p refs Presented at the Intern. Congr. on Eng and Food, Boston, 9-13 Aug. 1976
(Contract W-7405-eng-48)
(LBL-5275; Conf-7608115-1) Avail: NTIS HC A03/MF A01

The potential of cellulose as a source of energy and food is reviewed with consideration of raw material sources, processing methods, and economics. A tentative scheme for production of Torula yeast and ethanol from sugars produced by enzymatic hydrolysis of cellulose is described. ERA

N78-26588# Sandia Labs., Livermore, Calif. Systems Studies Div.
STEAEC: SOLAR THERMAL ELECTRIC ANNUAL ENERGY CALCULATOR DOCUMENTATION
J. B. Woodard and G. I. Miller Jan. 1978 78 p refs
(Contract EY-76-C-04-0789)
(SAND-77-8278) Avail: NTIS HC A05/MF A01

The Solar Thermal Electric Annual Energy Calculator (STEAEC) is a computer model which estimates the annual performance of a solar thermal electric power plant. Written in FORTRAN 4 for the CDC 6600, STEAEC is a quasi-steady state model with a constant (but user-variable) time step. Factors such as energy losses and delays incurred in start-up, effects of ambient weather conditions on plant operation and efficiency, effects of hold time and charge and discharge rates on deliverable energy in storage, subsystem maximum and minimum power limits, and auxiliary power requirements are taken into account in the computation of the annual electrical output of the plant. Default parameters may be easily modified through the use of NAMELIST inputs. ERA

N78-26589# Sandia Labs., Albuquerque, N. Mex.
COMPUTER ANALYSIS OF RESISTANCE AND NON-UNIFORM ILLUMINATION EFFECTS ON CONCENTRATOR SOLAR CELLS
K. W. Mitchell 1977 4 p refs Presented at the IEEE Intern. Electron Devices Meeting, Washington, D.C., 5 Dec. 1977
(Contracts EY-76-C-04-0789; AT(29-1)-789)
(SAND-77-1269C; Conf-771201) Avail: NTIS HC A02/MF A01

A computer program was developed to perform a two-dimensional matrix analysis of the voltage distribution in the top layer of concentrator solar cells in order to evaluate the important effects of top layer sheet resistance, contact grid geometry, and nonuniform illumination. The uniformity of illumination influences the cell efficiency through modifying the resistance losses in the cells. It is shown that introduction of lower top layer resistance (approximately 5 ohms/square) reduces the sensitivity of cell performance to illumination uniformity, which suggests important economic benefits for concentrator systems: reduced power loss (higher conversion efficiency) in solar cells at higher concentrations, and relaxed tolerances on illumination uniformity (lower concentrator cost). L.S.

N78-26590# Wormser Scientific Corp., Stamford, Conn.
SOLAR HOUSE HEATING SYSTEM USING REFLECTIVE PYRAMID OPTICAL CONDENSING SYSTEM: EVALUATION OF PERFORMANCE Final Report, 1 Jun. 1975 - 31 Dec. 1976
Nov. 1977 87 p
(Contracts EY-76-C-02-2769; E(11-1)-2769)
(COO-2769-2) Avail: NTIS HC A05/MF A01

The evaluation program for the pyramid optical condensing system is described. First, the prototype system, previously built was upgraded, instrumented, and evaluated. It was found to perform essentially as expected, but the open construction shown was found to have problems. A fully enclosed model Pyramidal Optics house was built. The solar system was instrumented as described. After a number of significant improvements were made in the optical concentrating system and the flat plate receiver assembly, the system was monitored throughout the winter of 1976/1977 and found to perform very well. The solar contribution to heating amounted to 70 percent during the severe winter months and is expected to exceed 80 percent throughout the year. The Pyramidal Optics system was found to have a number of economic and operational advantages. ERA

N78-26591# Carnegie-Mellon Univ., Pittsburgh, Pa.
DYNAMIC MODELS OF FALLING FILM EVAPORATORS FOR OCEAN THERMAL ENERGY CONVERSION PLANTS
S. A. Hetyei and Charles P. Neuman Jun. 1977 52 p refs
(Contract EY-76-S-02-2641)
(COO-2641-3) Avail: NTIS HC A04/MF A01

The pertinent physical laws of heat transfer and mass balance are applied to develop lumped parameter, dynamic and steady state models for shell and tube evaporators incorporating falling films. The dynamic evaporator model is specified by three ordinary differential equations and one algebraic equation with two time delays. It is shown that, in the steady state, this dynamic model reduces to the steady state evaporator model previously developed. It is demonstrated that the dynamic evaporator model is stable for perturbations around an equilibrium operating point. The dynamic evaporator model is being incorporated with the component models developed earlier to assemble a simulation model of the power cycle of an OTEC PLANT. The power cycle model will be simulated on the digital computer to ensure that the component models adequately characterize experimentally observed data. ERA

N78-26592# Electric Power Research Inst., Palo Alto, Calif. Fossil Fuel and Advanced Systems Div.
PERSPECTIVES ON UTILITY CENTRAL STATION PHOTOVOLTAIC APPLICATIONS
E. A. DeMeo and P. B. Bos Jan. 1978 54 p refs
(EPRI-ER-589-SR) Avail: NTIS HC A04/MF A01

Nominal cost and performance goals are developed for solar photovoltaic conversion devices intended for large-scale electric utility applications. The objective is to provide an improved basis for establishing research and development priorities for photovoltaic devices and conversion concepts. Comparisons are made among a number of generic power plant conceptual designs, with the aid of an array design parameter that is defined to include array-area-related costs, overall power plant efficiency, and average available insolation. The analysis indicates that flat plat approaches without concentration or tracking have good prospects for commercial viability if device conversion efficiencies near 10 percent can be combined with installed device costs under $20/sq m $2/sq ft and device lifetimes in excess of 20 years. Thin-film approaches have potential for achieving these cost and performance goals because of low material content and potentially low fabrication costs. ERA

N78-26593# General Electric Co., Philadelphia, Pa. Space Div.
MULTI-HUNDRED WATT RADIOISOTOPE THERMOELECTRIC GENERATOR PROGRAM Final Annual Report, 1976-1977
1978 466 p refs
(Contracts EX-76-C-16-3066; E(49-15)-3066)
(GESP-7134; GEMS-430) Avail: NTIS HC A20/MF A01

A description is given of the development, fabrication, and testing of the multi-hundred watt radioisotope thermoelectric generator. Results of a safety analysis are presented and qualification test results are presented. P.R.A.

N78-26594# Houston Univ., Tex. Solar Energy Lab.
LIQUID METAL COOLED SOLAR CENTRAL RECEIVER FEASIBILITY STUDY AND HELIOSTAT FIELD ANALYSIS. PART 1: LIQUID SODIUM COOLED CENTRAL RECEIVER SYSTEM CONCEPTUAL DESIGN Final Report, 15 Jun. 1976 - 15 Jun. 1977
Lorin L. Vant-Hull, Gerry Coleman (McDonnell Douglas Astronautics Co.), Tom Springer (Atomics Intern.), and Jerry Friefeld (Rocketdyne) Oct. 1977 162 p ref
(Contract EG-76-G-03-1426)
(ORO/5178-78-1) Avail: NTIS HC A08/MF A01

A conceptual design for a 100 MWe Solar Tower System employing liquid sodium as a heat transfer fluid and as a storage medium is generated. This design intentionally parallels the current commercial baseline design for a water/steam transfer fluid in order to enhance comparisons between the two approaches and to maximize the application of the limited funds in this study to the unique features of the liquid sodium system. Heat transfer at the receiver and the steam generator were considered in detail. Components for the liquid sodium loop currently under test on development were identified for a 10 MWe pilot plant and a 100 MWe demonstration plant. Economic comparisons with the MDAC water/steam receiver are favorable. ERA

N78-26595# Los Alamos Scientific Lab., N. Mex.
PROSPECTS FOR SOLAR ENERGY: THE IMPACT OF THE NATIONAL ENERGY PLAN
F. Roach, Scott Noll (New Mexico Univ., Albuquerque), Shaul Ben-David (New Mexico Univ., Albuquerque), Larry Bickle (L. W. Bickle and Assoc., Consulting Engineers, Albuquerque, New Mexico), and William Schulze (Univ. of Southern California, Los Angeles) Dec. 1977 53 p ref
(Contract W-7405-eng-36)
(LA-7064-MS) Avail: NTIS HC A04/MF A01

The National Energy Plan (NEP) sat as a goal the use of solar energy in two and a half million homes in 1985. A key provision of the NEP provides for the subsidization of solar equipment. The extent to which these subsidies might offset the impact of continued energy price control is examined. Regional prices and availability of conventional energy sources were compiled to obtain a current and consistent set of energy prices by state and energy type. Projections of conventional fuel price increases are made under both the NEP scenario and a projected scenario where all wellhead price controls are removed on natural gas and crude oil production. Solar system costs are developed for each state by fraction of Btu heating load provided. The total number of homes, projected energy savings, and sensitivity to heating loads, alternative energy costs and prices are included in the analysis. ERA

N78-26596# Avco-Everett Research Lab., Everett, Mass.
MHD GENERATOR COMPONENT DEVELOPMENT Quarterly

Report, Jan. - Mar. 1977
Apr. 1977 89 p refs
(Contract EF-77-C-01-2519)
(FE-2519-1) Avail: NTIS HC A05/MF A01

Radial flow disk experiments were performed at peak magnetic fields in the 4 to 4.5 tesla range. Maximum output power was in the 8 MW range with a corresponding enthalpy extraction of 7 per cent. The working fluid consisted of a mixture of N2, CO2, and H2. A comparison of measured and calculated plasm conductivities and MHD channel characteristics is presented. Channel calculations predict accurately the Hall effect. Results of other experimental tasks are also presented. P.R.A.

N78-26597# Brookhaven National Lab., Upton, N. Y.
FUEL CELLS: APPLIED RESEARCH FUEL CELL MATERIALS AND ELECTROCATALYSIS Annual Report, Jan. - Dec. 1976
S. Srinivasan and H. S. Isaacs Sep. 1977 32 p refs
(Contract EY-76-C-02-0016)
(BNL-50652) Avail: NTIS HC A03/MF A01

Research is described on electrocatalysis of fuel cell reactions including the topics (1) mixed oxides as oxygen electrodes, (2) electrolyte effects on the oxygen reduction reaction, (3) anion effects on the oxygen reduction reaction, and (4) selection and evaluation of electrocatalysts for oxygen reduction in KHCO3/K2CO3 buffered electrolytes. Phosphoric acid fuel cell studies include inhibition of sintering of fuel cell catalyst particles: electrochemical methods for surface regeneration and temperature effects on the oxygen reduction reaction a platinum in phosphoric acid electrolyte. Research on the characterization of overpotentials of solid electrolyte fuel cells and selection and evaluation of interconnector materials for solid electrolyte fuelcells is summarized. Author (ERA)

N78-26598# Honeywell, Inc., Minneapolis, Minn. Energy Resources Center.
MIXED STRATEGIES FOR ENERGY CONSERVATION AND ALTERNATIVE ENERGY UTILIZATION (SOLAR) IN BUILDINGS, VOLUME 1. EXECUTIVE SUMMARY Final Report
Jun. 1977 62 p
(Contract EY-76-C-03-1234)
(SAN/1234-1/1) Avail: NTIS HC A04/MF A01

Information is presented on the cost effectiveness of a strategy for reducing energy consumption in buildings by combining energy conservation techniques, such as improved building design and thermal insulation with solar heating and cooling systems. It is concluded, from computer simulation studies used to determine building loads and the interaction of the solar system, that energy conservation is the most cost effective way to save energy in all buildings at any location, and that solar systems are currently not cost effective. ERA

N78-26599# National Science Council, Dublin (Ireland). Energy Group.
ANALYSIS OF THE IMPACT OF HEAT PUMP TECHNOLOGY ON THE IRISH ENERGY SYSTEM TO THE YEAR 2000. ENERGY CASE STUDY SERIES: NO. 2
J. Brady Sep. 1977 103 p refs Presented at the Energy Workshop of the Natl. Sci. Council of Ireland, Dublin, 13 Sep. 1977
(CONF-770956-2) Avail: NTIS HC A06/MF A01

The methodology involved the measurement of the potential impact against a base reference energy system for various heat pump strategies. A short analysis of the implementation rates and their effect on technology impact was also carried out. ERA

N78-26600# Oak Ridge National Lab., Tenn.
UNITARY AIR-TO-AIR HEAT PUMPS
J. E. Christian Jul. 1977 51 p refs
(Contract W-31-109-eng-38)
(ANL/CES/TE-77-10) Avail: NTIS HC A04/MF A01

Commercially available unitary heat pumps ranging from nominal capacities of 1.5 to 45 tons were evaluated. The nominal COP of the heat pump models, selected as representative, vary from 2.4 to 2.9. Seasonal COPs for heat pump installations and single-family dwellings are reported to vary from 2.5 to 1.1, depending on climate. For cooling performance, the nominal EER's vary from 6.5 to 8.7. Representative part-load performance curves along with cost estimating and reliability data are provided to aid: (1) the systems design engineer to select suitably sized heat pumps based on life-cycle cost analyses, and (2) the computer programmer to develop a simulation code for heat pumps operating in an Integrated Community Energy System. ERA

N78-26601# Oak Ridge National Lab., Tenn.
MOLTEN CARBONATE FUEL CELL RESEARCH AT ORNL 2: THEORETICAL AND EXPERIMENTAL TRANSPORT STUDIES, THERMOCHEMISTRY, AND ELECTRON MICROSCOPY
J. Braunstein, H. R. Bronstein, S. Cantor, D. E. Heatherly, L. D. Hulett, R. L. Shermann, C. E. Vallet, and G. Watts Dec. 1977 22 p refs
(Contract W-7405-eng-26)
(ORNL/TM-6168/V2) Avail: NTIS HC A02/MF A01

Theroetical and modeling studies of mass transport in molten Li2CO3-K2CO3 mixtures were extended for the prediction of possible composition gradients. A parametric representation was developed that incorporates the effects of current density, electrode separation, initial composition, effective Li/K mobility ratio and effective interdiffusion coefficient. Electrolysis experiments designed to test the model and simulate mass transport in an operating fuel cell are being carried out by analysis of emf-time relaxation curves measured after electrolysis. Direct analysis of composition profiles in electrolyte tiles is being developed by means of scanning electron microscopy with energy dispersive X-ray fluorescence. Differential scanning calorimetry was applied to the thermochemistry of the carbonate electrolyte and lithium aluminate matrix. ERA

N78-26602# Sandia Labs., Albuquerque, N. Mex.
TRANSIENT BEHAVIOR OF THE FLUID AND ELECTRICAL PROPERTIES IN THE TURBULENT BOUNDARY LAYER OF AN MHD CHANNEL
A. J. Russo and F. G. Blottner 1977 14 p refs
(Contract EY-76-C-04-0789)
(SAND-77-1952C; Conf-780307-1) Avail: NTIS HC A02/MF A01

The governing two-dimensional equations for the MHD boundary layer flow are solved numerically to predict the transient response to a suddenly applied current. The onset of inter-electrode breakdown was predicted; steady-state fluid and electrical properties were calculated after breakdown had occurred but with three-dimensional effects neglected; and skin friction and heat transfer were for typical flow conditions that occur in MHD coal combustion generators. ERA

N78-26603# Sandia Labs., Albuquerque, N. Mex.
NUMERICAL CODES FOR MHD FLOWS Quarterly Technical Progress Report, Apr. - Jun. 1977
K. J. Touryan, F. G. Blottner, A. J. Russo, and J. G. Taylor Nov. 1977 23 p refs
(Contract EY-76-C-04-0789)
(SAND-77-1659) Avail: NTIS HC A02/MF A01

Numerical techniques and codes for characterizing coal-combustion-operated MHD generators and diffusers are developed. The purpose for this activity is two-fold: (1) to provide the MHD Division of the Department of Energy with evaluative guidelines in selecting and exercising channel codes: (2) to provide users with codes to design MHD channels/diffusers and evaluate their performance. Progress is reported on the following tasks: (1) Unsteady One-Dimensional Channel Code, to modify an existing time-dependent code to include MHD effects for approximate predictions of the flow from the combustion chamber through the differ; (2) Steady Multidimensional Channel Codes, to develop codes for predicting the complete steady-inviscid-viscous flow across the duct in an MHD generator and diffuser; (3) Slag Layer, to adapt an existing code to predict the stability conditions for slag layers which are driven by turbulent exterior flows and to develop a code for predicting slag layer growth. ERA

N78-26604# Sandia Labs., Albuquerque, N. Mex.
NUMERICAL CODES FOR MHD FLOWS Quarterly Technical Progress Report, Jan. - Mar. 1977
K. J. Touryan, F. G. Blottner, A. J. Russo, and J. G. Taylor Nov. 1977 42 p

(Contract EY-76-C-04-0789)
(SAND-77-1658) Avail: NTIS HC A03/MF A01

A previously developed code for an inviscid perfect gas was adapted to the calculation of the flow from the combustion chamber through the MHD channel. Verification of the quasi-two-dimensional approximation was obtained. Using an electrodynamics code which calculates current and potential fields in an expanding section of MHD channel, routines for iteratively interchanging data with the two-dimensional fluid code were developed. The equations modelling slag vapor condensation in a coal combustion MHD generator were simplified to provide a more tractable problem for initial study. Results of other progress are also reported. P.R.A.

N78-26605# Sandia Labs., Albuquerque, N. Mex.
NUMERICAL CODES FOR MHD FLOWS Quarterly Technical Progress Report, Oct. - Dec. 1976
K. J. Touryan, F. G. Blottner, A. J. Russo, and J. G. Taylor Nov. 1977 30 p
(Contract EY-76-C-04-0789)
(SAND-77-1657) Avail: NTIS HC A02/MF A01

A technique was developed which allows the two-dimensional fluids dynamic code to be used to predict the flow in channels with three-dimensional flow occurring. For the conditions investigated, reasonably accurate results were obtained. This approach is limited to channel flows where the side wall boundary layers have not merged together. The axisymmetric fluid dynamic channel flow code was made operational. Calculations compare favorably with experimental results for low-speed turbulent airflow through a tube with wall cooling. A two-dimensional electrodynamics code suitable for studies of entry and exit phenomena, effects of magnetic field variations, conductivity variations, electrode current distributions, and overall performance characteristics of a Faraday-connected generator channel was developed. Parametric studies with the slag stability code showed that the most destabilizing case, both for subsonic and supersonic channel flows in the presence of shear and pressure perturbations, is when the normal component of the J x B force acts from the slag into the gas and the axial component acts downstream. The equations and boundary conditions were formulated to model ash vapor condensation in coal combustion MHD generators. ERA

N78-26606# Sandia Labs., Albuquerque, N. Mex.
NUMERICAL CODES FOR MHD FLOWS Quarterly Technical Progress Report, Jul. - Sep. 1976
K. J. Touryan, F. G. Blottner, A. J. Russo, and J. G. Taylor Nov. 1977 30 p refs
(Contract EY-76-C-04-0789)
(SAND-77-1656) Avail: NTIS HC A02/MF A01

Initial development has been completed on codes for predicting the performance of MHD generators. The fluid dynamics code describes compressible flow through a variable height 2-D or axisymmetric channel. At present, the code is restricted to a calorically perfect gas with a linear or Sutherland viscosity model. The Prandtl number is constant, not necessarily unity. An eddy viscosity turbulent model enables computation of laminar and turbulent flows, including transition. To initiate the computation, several initial profile options are available. The fluid dynamics code will be coupled with an electrodynamics code which has been developed to predict the electrical properties in MHD channels. The electrodynamics code uses boundary conditions appropriate for a Faraday generator and allows variable fields of conductivity, Hall parameter, velocity components and magnetic field strength. The stability of liquid slag layers on channel walls was analyzed using linear disturbance theory. ERA

N78-26607# General Atomic Co., San Diego, Calif.
MASTER TEST PLAN FOR THE MB-75 mW (B) GENERATORS
N. B. Elsner, J. C. Bass, and H. G. Staley Nov. 1977 40 p refs
(Contract EY-76-C-03-0167-060)
(GA-A-14717) Avail: NTIS HC A03/MF A01

Five 75 mW radioisotope thermoelectric generators (RTGs) and two electrically heated thermoelectrically heated generators (ETGs) are to be supplied. A facility is not available that can accommodate RTG mechanical shock and vibration testing and this testing will be performed on ETGs. The tests to be conducted will fall into four categories: (1) materials evaluation; (2) component evaluation; (3) ETG evaluation; and (4) RTG evaluation. The shock and vibration test procedures are described. ERA

N78-26608# Alabama Univ., Huntsville. Kenneth E. Johnson Environmental and Energy Center.
SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM CONTRACTOR'S REVIEW. SUMMARY AND ANALYSIS OF WORKSHOP AND PANEL SESSIONS
D. L. Christensen Dec. 1977 43 p Conf. held at New Orleans, 5-7 Dec. 1977
(Contract EC-78-C-01-4131)
(CONF-771229-Summ) Avail: NTIS HC A03/MF A01

The Workshop Summary contains the results and summaries of the five workshops and panel session held on the final day of the program. The workshops reflected much of the interests and concerns of the various attendees and generally represent a summary of the overall program. The workshops included: (1) design concepts, philosophy and techniques; (2) installation, construction and hardware procurement; (3) operational and performance factors; (4) economic, environmental, societal and institutional issues; and (5) overview of National Demonstration Program. ERA

N78-26609# Boeing Engineering and Construction, Seattle, Wash.
CENTRAL RECEIVER SOLAR THERMAL POWER SYSTEM: COLLECTOR SUBSYSTEM Final Report
15 Aug. 1977 154 p refs
(Contract EY-76-C-03-1111)
(SAN/1111-76-7) Avail: NTIS HC A08/MF A01

Three heliostats and a drive and control assembly were fabricated and tested to provide design data and verification of the preliminary design. In addition, an extensive evaluation program was conducted on the key plastic materials used in the protective enclosure and reflector. Performance and environmental exposure tests on large scale heliostats were conducted over an eight month period at a desert test site in northeast Oregon to determine optical performance, demonstrate operation of the drive and control assembly in the various operational modes, and verify survivability of hardware in the environment. Plastic materials evaluation tests included measurement of mechanical and optical properties, creep, chemical exposure, cleanability, accelerated simulated sunlight, and actual desert sunshine exposure tests. ERA

N78-26610# Tennessee Univ., Knoxville.
IN SITU CONVERSION OF COAL Final Report, 1 Jun. 1975 - 30 Nov. 1977
John W. Larsen Oct. 1977 16 p refs
(Contract EY-76-S-02-0066)
(COO-0066-2) Avail: NTIS HC A02/MF A01

Intermolecular hydride transfer from a variety of compounds to carbonium ions was reviewed. The reaction developed uses BF3H2O as the acid and Et3SiH as the hydride donor. The organic compound to be reduced is protonated by the BF3H2O to give a carbonium ion which then hydride abstracts from the ET3SIH. ERA

N78-26611# California Univ., Livermore. Lawrence Livermore Lab.
ENERGY AND RESOURCE PLANNING GROUP Annual Report, FY 1977
William J. Ramsey, ed. 27 Oct. 1977 31 p refs
(Contract W-7405-eng-48)
(UCRL-50029-77) Avail: NTIS HC A03/MF A01

A major effort was devoted to transportation planning and analysis; system analysis, conceptual design studies, and planning support to the Transportation Energy Conservation Division of DOE. Also, a multilaboratory study of energy-storage power systems for automobiles was directed for DOE and results published. The results show while some of the energy storage power vehicles can provide performance comparable to that of conventional internal combustion engine vehicles, they would be heavier and more expensive. The value of regenerative braking for vehicles in recovering kinetic energy was assessed. Such

braking would have the most benefit in vehicles already equipped with energy storage systems and whose deriving cycle involves many stops and starts. A conceptual design study on a possible transition electric vehicle was completed. Such a vehicle would be battery/flywheel powered, with a small Internal combustion engine for range extension. ERA

N78-26612# Stanford Univ., Calif. Dept. of Operations Research.

ETA-MACRO: A MODEL OF ENERGY-ECONOMY INTERACTIONS

Alan S. Manne Dec. 1977 82 p refs Sponsored by EPRI (EPRI-EA-592) Avail: NTIS HC A05/MF A01

A market economy is simulated through a dynamic nonlinear optimization process. To describe the production relationship within this economy, two dynamic submodels are incorporated: ETA, a process analysis for energy technology assessment; and a macroeconomic growth model providing for substitution between capital, labor, and energy inputs. The focus is on one specific policy option--banning the introduction of additional civilian nuclear power plants in the U.S. Under base-case assumptions, it turned out that a no nuclear policy would have negligible macroeconomic effects prior to the year 2000, but that it could lead to an annual loss of the order of $100 billions by the year 2010. ERA

N78-26613# Oak Ridge National Lab., Tenn.

POWER PLANT REJECT HEAT UTILIZATION: AN ASSESSMENT OF THE POTENTIAL FOR WIDE-SCALE IMPLEMENTATION

M. Olszewski Dec. 1977 51 p refs
(Contract W-7405-eng-26)
(ORNL/TM-5841) Avail: NTIS HC A04/MF A01

Economic and heat utilization merits of plant reject heat utilization systems were assessed in an effort to indicate those technologies that show the greatest potential for wide-scale implementation in the power generating industry. It was assumed that these systems replaced the cooling tower as the primary condenser cooling water heat dissipation system. Implementation potential and user incentive considerations were used in assessing the technologies. Assessment of the implementation potential included economic, marketing, and power plant performance criteria. The user incentive assessment essentially viewed the use of reject heat from the user's perspective. The overall assessment indicated that extensive pond aquaculture offered the greatest potential for wide-scale implementation. ERA

N78-26614# Royal Netherlands Aircraft Factories Fokker, Schiphol-Oost. Space Dept.

SPECIFICATION FOR THERMAL CYCLING TEST ON SAMPLE OF NIVR SOLAR ARRAYS

J. Seeboldt 20 Dec. 1976 7 p
(FOK-RV-77-09) Avail: NTIS HC A02/MF A01

The thermal cyclic tests to be carried out on a sample of NIVR solar panel substrate is specified. In this substrate a number of connections between different material are present such as carbon fiber to resin, Al alloy honeycomb to carbon fiber composite facesheet, and U-shaped edgemember to honeycomb core. The objective of the test is to demonstrate that this sample can survive 700 thermal cycles between -170 C and +80 C (representative for the service life of the solar array) without delamination or other failures. Author (ESA)

N78-26615# AEG-Telefunken, Frankfurt am Main (West Germany).

DESIGN ANALYSIS AND TESTING OF SOLAR CELL MODULES, PHASE 2 Final Report

A. Rukwied, H. J. Lipp, J. Koch, R. Buhs, and H. Reyer Paris ESA [1977] 316 p Prepared jointly with ERNO Raumfahrttech.
(Contract ESTEC-2572/75-HP)
(ESA-CR(P)-1001) Avail: NTIS HC A14/MF A01

Elasto-mechanical properties of two different solar cell module structures were determined: a rigid structure made of glass fiber reinforced epoxy face sheets covering aluminum honeycomb and a flexible structure made of glass fiber reinforced Kapton. Properties determined in two different structure directions were: thermal expansion coefficient, Young's modules, fracture stress, bending stiffness, transverse rigidity and shear stiffness. The investigations were performed between -196 and +195C. A computer program for calculating interactions between the structures considered and the solar cells was modified by adding some special soubroutines. The behavior of the sandwich structure cell was determined for external and internal loads. Analytical results are supported by verification tests. ESA

N78-26616# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.

A PROJECT TO REDUCE THE IMPACT OF ENERGY SHORTAGES AND COST INCREASES ON INDUSTRIAL PRODUCTION IN THE SOUTHEAST. VOLUME 1: PROJECT OVERVIEW Final Report

Feb. 1978 29 p 3 Vol.
(Grant EDA-99-6-09359-1)
(PB-278078/1; EDA-78-056) Avail: NTIS HC A03/MF A01; HC also available in set of 3 reports HC E09, PB-278077-SET CSCL 10A

The goal is to reduce the impact of energy shortages and increased energy costs on employment and industrial expansion by creation and stimulation of industrial energy conservation programs. Project activities and major end items that were produced are described. Project methodology, other benefits of the project, and recommendations for future work of this type are included. GRA

N78-26617# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.

A PROJECT TO REDUCE THE IMPACT OF ENERGY SHORTAGES AND COST INCREASES ON INDUSTRIAL PRODUCTION IN THE SOUTHEAST. VOLUME 2: CASE STUDY AND TECHNICAL ASSISTANCE Final Report

Feb. 1978 246 p 3 Vol.
(Grant EDA-78-057)
(PB-278079/9; EDA-78-057) Avail: NTIS HC A11/MF A01; HC also available in set of 3 reports HC E09, PB-278077-SET CSCL 10A

A compilation is given of case study and technical assistance information catalogued by industry. The volume also includes a compilation by industry of specific energy conservation indeas showing estimated costs and savings. It is designed as a working reference for individuals who would provide technical assistance to industry. It describes the make-up of industries, the technical energy conserving opportunities within the industries, and specific projects undertaken. GRA

N78-26618# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.

A PROJECT TO REDUCE THE IMPACT OF ENERGY SHORTAGES AND COST INCREASES ON INDUSTRIAL PRODUCTION IN THE SOUTHEAST. VOLUME 3: TRANSFER PACKAGE Final Report

Feb. 1978 130 p 3 Vol.
(Grant EDA-99-6-09359-1)
(PB-278080/7; EDA-78-058) Avail: NTIS HC A07/MF A01; HC also available in set of 3 reports HC E09, PB-278077-SET CSCL 10A

Information is given to provide a basis for conducting a similar program in other states. Program methodology is described in detail as are methods for selecting participating firms. In addition, training materials for technical workshops are included. GRA

N78-26619# American Mathematical Society, Providence, R.I.

MATHEMATICAL ASPECTS OF PRODUCTION AND DISTRIBUTION OF ENERGY: PROCEEDINGS OF SYMPOSIA IN APPLIED MATHEMATICS OF THE AMERICAN MATHEMATICAL SOCIETY, VOLUME 21

Peter D. Lax, ed. 1977 139 p refs Symp. held in San Antonio, 20-21 Jan. 1976
(Contract E(11-1)-2409; Grant NSF MCS-76-10597)
(PB-278350/4; ISBN-0-8218-0121-X) Avail: NTIS HC A07/MF A01 CSCL 10A

The subjects are grouped in two categories: those having to do with the mathematical problems involved in the technology of energy production, and those which have to do with the the mathematical problems of estimating the resources of energy

and the efficient distribution of available energy. The models for energy production are in the form of fairly complicated systems of partial differential equations whose solutions require techniques of finite difference schemes, finite element methods, and Fourier techniques. The models of energy distribution are large networks; their analysis is based on techniques from statistics, linear programming, dynamic programming, and techniques of optimization. GRA

N78-26620# Oak Ridge Associated Universities, Tenn.
ENVIRONMENTAL EFFECTS OF ENERGY
1976 32 p Proc. of Conf. held at Savannah, 2-3 Dec. 1976 Sponsored in part by EPA
(Contract DI-14-16-008-1237)
(PB-278169/8; FWS/OBS-76/52) Avail: NTIS HC A03/MF A01 CSCL 10A

Ecological effects and environmental transport processes of an EPA program were reviewed. Topics discussed include: energy and ecology; assessment of interagency research and its management implications; dilemmas in environmental effects research and energy development; a framework for assessment; and the Federal inventory of energy related biomedical and environmental research. GRA

N78-26621# Northeastern Legislative Leaders Energy Research Project.
ENERGY POLICY MAKING IN THE NORTHEAST: A DIRECTORY OF STATE PROGRAMS AND INSTITUTIONS
Sep. 1977 132 p
(Grant NSF ISP-74-43894)
(PB-277503/9; NSF/RA-770213) Avail: NTIS HC A07/MF A01 CSCL 10A

An overview is provided of the current energy related duties and programs of governmental institutions in Connecticut, Delaware, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island and Vermont. State legislative institutions were included along with executive bodies. The directory is arranged by states, separated into the two categories of executive and legislative branches. For each agency the following information concerning energy policy making is included: structure; responsibilities (purpose, authority, energy related duties, energy related activities); administration; and publications. GRA

N78-26622# National Bureau of Standards, Washington, D. C.
ENERGY MANAGEMENT FOR FURNACES, KILNS, AND OVENS, NBS HANDBOOK 124 Final Report
L. A. Wood, J. F. Ward, and K. G. Kreider Jan. 1978 47 p refs Sponsored in part by DOE
(PB-277704/3; NBS-HR-124; LC-77-608122) Avail: NTIS HC A03/MF A01 CSCL 13A

A guide to making decisions for energy savings in equipment such as furnaces, kilns, and ovens is given. The major technique described is the heat balance. Examples of heat balances were used to identify energy losses on a batch furnace, a continuous paint dryer oven, and slot forging furnace. Typical energy conservation opportunities in combustion control, insulation, etc. are discussed. Simplified methods of calculation and measurement are given. Benefit/cost analysis and the time required to recoup investment are described as means of evaluating energy-saving investments. GRA

N78-26327# General Motors Research Labs., Warren, Mich.
A TEST INSTALLATION OF LITHIUM HYDROXIDE HEAT STORAGE SYSTEM
Michael Tsou *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 7: Thermal Energy Storage and Publ. List, 7.1 Thermal Energy Storage, 7.2 List of Gen. Motors Stirling Eng. Publ. Apr. 1978 14 p (For availability see N78-26326 17-31)
(GMR-2690-Sect-7.101) Avail: NTIS HC A11/MF A01

N78-26328# General Motors Research Labs., Warren, Mich.
DEVELOPMENT OF A LITHIUM HYDROXIDE HEAT STORAGE SYSTEM Progress Report
Michael Tsou *In* Its A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 7: Thermal Energy Storage and Publ. List, 7.1 Thermal Energy storage, 7.2 List of Gen. Motors Stirling Eng. Publ. Apr. 1978 16 p (For availability see N78-26326 17-31)
(GMR-2690-Sect-7.102) Avail: NTIS HC A11/MF A01

N78-26329# General Motors Research Labs., Warren, Mich.
THERMAL ENERGY STORAGE FOR ROAD VEHICLE PROPULSION
Worth H. Percival *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 7: Thermal Energy Storage and Publ. Lists, 7.1 Thermal Energy Storage, 7.2 List of Gen. Motors Stirling Eng. Publ. Apr. 1978 23 p (For availability see N78-26326 17-31)
(GMR-2690-Sect-7.103) Avail: NTIS HC A11/MF A01

N78-26333# General Motors Research Labs., Warren, Mich.
ENERGY STORAGE SYSTEMS COMPLEMENT THE STIRLING ENGINE
In its A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 7: Thermal Energy Storage and Publ. List, 7.1 Thermal Energy Storage, 7.2 List of Gen. Motors Stirling Eng. Publ. Apr. 1978 3 p (For availability see N78-26326 17-31)
(GMR-2690-Sect-7.107) Avail: NTIS HC A11/MF A01

N78-26334# General Motors Research Labs., Warren, Mich.
THERMAL ENERGY STORAGE--STIRLING ENGINE POWER PLANTS 2. CALCULATED ENERGY TRANSFER RATES FROM SOLIDIFYING LITHIUM FLUORIDE TO A PLAIN-TUBE HEATER
A. Cocanower *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res, 1958 to 1970. Pt. 7: Thermal Energy Storage and Publ. List, 7.1 Thermal Energy Storage, 7.2 List of Gen. Motors Stirling Eng. Publ. Apr. 1978 49 p refs (For availability see N78-26326 17-31)
(GMR-2690-Sect-7.108) Avail: NTIS HC A11/MF A01

N78-26337# General Motors Research Labs., Warren, Mich.
THERMAL ENERGY STORAGE-STIRLING ENGINE POWER-PLANTS FOR ROAD VEHICLES
James N. Mattavi *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 7: Thermal Energy Storage and Publ. List, 7.1 Thermal Energy Storage, 7.2 List of Gen. Motors Stirling Eng. Publ. Apr. 1978 23 p refs (For availability see N78-26326 17-31)
(GMR-2690-Sect-7.111) Avail: NTIS HC A11/MF A01

N78-26865*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
STATUS OF PHOTOELECTROCHEMICAL PRODUCTION OF HYDROGEN AND ELECTRICAL ENERGY
Charles E. Byvik and Gilbert H. Walker *In* Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 244-247 refs (For availability see N78-26837 17-70)
Avail: NTIS HC A13/MF A01 CSCL 10A

N78-26869*# Illinois Inst. of Tech., Chicago.
GAS CORE REACTORS FOR COAL GASIFICATION
Herbert Weinstein *In* Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 269-274 refs (For availability see N78-26837 17-70)
(Grant NsG-7039)
Avail: NTIS HC A13/MF A01 CSCL 10A

45 ENVIRONMENT POLLUTION

Includes air, noise, thermal and water pollution; environment monitoring; and contamination control.

N78-26623 Louisiana State Univ. and A&M Coll., Baton Rouge.
SPECIFIC DETERMINATION OF AIRBORNE SULFATES AND SULFURIC ACID Ph.D. Thesis
Purnendu Kumar Dasgupta 1977 331 p
Avail: Univ. Microfilms Order No. 78-07543

A method to determine trace levels or airborne sulfuric acid in the ambient atmosphere was developed. The procedure is spectrophotometric and a detection limit of 100 nanograms sulfate was achieved. The method was also applied to aqueous samples

and a limit of detection of 5 nanograms was achieved by ring oven techniques. Pathways for the formulation of atmospheric sulfates toxicological evaluation of sulfuric acid and its salts, and the need for an ambient air quality standard for these species are discussed. In depth reviews of available methods for the determination of sulfuric acid and sulfates in air and water are included. The chemistry of a new class of compounds, nitro substituted 2 aminoperimidines, which form the basis of the measurement is also described. Thermal, spectral and polarographic data for five new compounds belonging to this family are given. Dissert. Abstr.

N78-26624 Pennsylvania State Univ., University Park.
A STATISTICAL ANALYSIS OF THE OPERATING PARAMETERS WHICH AFFECT AIR POLLUTION EMISSIONS FROM CUPOLAS Ph.D. Thesis
John William Davis 1977 203 p
Avail: Univ. Microfilms Order No. 7808344

Seven iron production foundries were visited and samples taken under conditions prescribed by the experimental plan. The cupolas varied in size and blast temperature and measurements were taken at two blast rate and two iron-coke ratio levels. At two of the foundries only one iron-coke ratio level was measured. The data obtained from these tests were analyzed using the analysis of variance and other statistical techniques where applicable. Results indicated that blast rate, blast temperature and cupola size affected particle emissions and the latter two also affected the particle size distribution. The particle size information showed a consistant distribution at all seven foundries with a sizable fraction of the particles less than 1.0 micrometers in diameter. Dissert. Abstr.

N78-26625# Colorado State Univ., Fort Collins.
LEAD IN THE ENVIRONMENT
William R. Boggess (Illinois Univ. at Urbana-Champaign) and Bobby G. Wixson (Missouri Univ., Rolla) 1977 264 p refs
(Grants NSF ENV-74-24276; NSF AEN-74-17624)
(PB-278278/7; NSF/RA-770214) Avail: NTIS HC A12/MF A01 CSCL 13B

The occurrence, transport, distribution, and possible environmental effects of lead are investigated. Analytical techniques and methodologies were developed for determining lead and following it from source to ultimate sink through both living and nonliving ecosystem components. Author

N78-26626# Dayton Univ. Research Inst., Ohio.
EVALUATION OF POTENTIAL INSPECTION/MAINTENANCE BENEFITS ON VEHICLES OPERATED AT HIGH ALTITUDES
Alan P. Berens and Michael Hill Sep. 1977 214 p refs
(Contract EPA-68-03-2384)
(PB-278708/3; EPA-460/3-77-018) Avail: NTIS HC A10/MF A01 CSCL 13B

Analysis of laboratory data collected at high altitude is given. The effectiveness of inspection/maintenance was estimated, I/M the correlation between the Federal Test Procedure (FTP) and various short inspection tests was correlated, and relationships which exist between emissions, engine condition, and vehicle usage were examined. GRA

N78-26627# Environmental Monitoring and Support Lab., Research Triangle Park, N. C.
THE LOS ANGELES CATALYST STUDY SYMPOSIUM Final Report
Thomas R. Hauser Jun. 1977 464 p refs
(PB-278305/8; EPA-600/4-77-036) Avail: NTIS HC A20/MF A01 CSCL 07D

Papers covering such areas as sampling and analytical methods for aerosols, including NH4(+), SO4(2-), Pb and NO3; quality assurance procedures; statistical analysis of LACS data; and trends in ambient air pollution concentration measured just off a heavily travelled roadway in Los Angeles are presented. GRA

N78-26628# Missouri Univ., Rolla. Missouri Water Resources Research Center.
. REDICTING POLLUTANT DISPERSION IN RIVERS Final Report
Henry Liu and John E. Dieter 1 Jan. 1978 16 p refs
(Contracts DI-14-34-0001-7053)
(PB-278048/4; W78-04495) Avail: NTIS HC A02/MF A01 CSCL 13B

A method to predict the dispersion coefficient of natural streams was evaluated. The dimensionless dispersion coefficient beta, where beta = (U sub t)(R sup 3)(D sub L)/(Q sup 2), is directly proportional to the Darcy-Weisbach frictional factor f. This established an analogy between one-dimensional dispersion and friction. The effect of channel cross-sectional geometry on the dimensionless dispersion coefficient beta is shown. GRA

N78-26629# Texas A&M Univ., College Station. Ocean Engineering Program.
ENVIRONMENTAL CONSIDERATIONS RELATING TO OPERATION AND MAINTENANCE OF THE TEXAS GULF INTRACOASTAL WATERWAY
Wesley P. James, Steven Giesler, Robert DeOtte, and Masamichi Inoue Nov. 1977 239 p refs
(Grant NOAA-04-6-158-44012)
(PB-278146/6; COE-208; TAMU-SG-78-204;
NOAA-78020202) Avail: NTIS HC A11/MF A01 CSCL 13B

Potentially adverse environmental factors other than dredging were associated with the operation and maintenance of the Texas Gulf Intracoastal Waterway. Field sampling was conducted along the waterway in January, May, and August 1975 to ascertain background water and sediment quality. To study the flow between Galveston Bay and Sabine Lake, a numerical model study was conducted of this reach of the waterway. Satellite imagery was used in the Low Laguna Madre to study the circulation patterns and sedimentation rates. GRA

N78-26630# Rutgers - The State Univ., New Brunswick, N. J. Water Resources Research Inst.
RUNOFF POLLUTION FROM MULTIPLE FAMILY HOUSING
William Whipple, Jr., Joseph V. Hunter, and Shaw L. Yu Nov. 1977 20 p refs
(Contract DI-14-34-0001-8032)
(PB-277805/8; W78-04102) Avail: NTIS HC A02/MF A01 CSCL 13B

Storm event data were obtained from a planned multiple unit housing development near Hightstown, N. J., using samples taken every 10 minutes throughout the storm at two different storm sewers. Results show that BOD and phosphate pollution from runoff were much higher per housing unit than from runoff of single family housing, perhaps twice as high. There is also considerable ammonia. Metals pollution from multiple family housing is comparable to that from single family housing with considerable commercial development. The results are significant for areawide water quality planning in metropolitan areas, where projection of future pollution loadings depends upon the land use. GRA

N78-26631# TRW, Inc., Redondo Beach, Calif. Environmental Engineering Div.
AN IMPLEMENTATION PLAN FOR SUSPENDED PARTICULATE MATTER IN THE PHOENIX AREA: VOLUME 2. EMISSION INVENTORY Final Report
George Richard, Ronald Tan, and James Avery Dec. 1977 218 p refs
(Contract EPA-68-01-3152)
(PB-278178/9) Avail: NTIS HC A10/MF A01 CSCL 13B

An evaluation of particulate source emissions throughout Phoenix is given, including a detailed explanation of methodology employed to derive the baseyear and projected baseline emission estimates. The estimates were conducted for three major particulate emission source categories: conventional sources, anthropogenic fugitive dust emissions, and wind blown fugitive dust emissions. M.V.

N78-26632# Oak Ridge National Lab., Tenn.
ECOSYSTEM PARADIGM FOR ECOLOGY
P. L. Johnson, ed. Apr. 1977 18 p refs Sponsored by DOE
(ORAU-129) Avail: NTIS HC A02/MF A01

The nature of ecosystem ecology as a science is discussed with emphasis on the current scope and focus of ecosystem ecology. A set of theorems which constitute the theoretical basis of ecology is presented. J.M.S.

N78-26633# Battelle Pacific Northwest Labs., Richland, Wash.
MAP3S PRECIPITATION CHEMISTRY NETWORK Periodic Summary Report No. 1, Sep. 1976 - Jun. 1977
Oct. 1977 176 p refs
(Contract EY-76-C-06-1830)
(PNL-2402) Avail: NTIS HC A09/MF A01

A large-scale atmospheric research effort conducted to develop the means for modeling and predicting the effect of present and future pollutant emissions from power production processes is described. Emphasis is placed on emissions resulting from coal burning and the research is focused on the northeastern United States. Major pollutants of interest include the sulfur and nitrogen oxides and their reaction products, hydrocarbons, trace elements, and particulates. Precipitation event samples were collected and analyzed for 11 pollutant species using ion chromatography, automated wet chemistry, atomic absorption spectrophotometry, and other standard techniques. The concentration data collected over the period September 22, 1976 to July 1, 1977 are listed. J.M.S.

N78-26634# Battelle Pacific Northwest Labs., Richland, Wash.
EFFECT OF LIQUID WASTE DISCHARGES FROM STEAM GENERATING FACILITIES
H. E. McGuire, Jr. Sep. 1977 54 p refs
(Contract EY-76-C-06-1830)
(BNWL-2393) Avail: NTIS HC A04/MF A01

A simplified model for use in approximately determining the effects of these discharges is given. Four basic fuels are used in steam electric power plants: three fossil fuels--coal, natural gas, and oil; and uranium--presently the basic fuel of nuclear power. Coal and uranium are expected to be the major fuels in future years. The following power plant effluents are considered: heat, chlorine, copper, total dissolved solids, suspended solids, pH, oil and grease, iron, zinc, chrome, phosphorus, and trace radionuclides. ERA

N78-26635# Los Alamos Scientific Lab., N. Mex.
INTEGRATED MINICOMPUTER ALPHA ANALYSIS SYSTEM
Dennis G. Vasilik, Dale E. Coy, Max Seamons, Richard W. Henderson, Leonard L. Romero, and Debra Ann Thomson 1978 33 p Presented at Health Phys. Soc. 11th Midyear Topical Symp. on Radiation Monitoring, San Diego, Calif., 17 Jan. 1978
(Contract W-7405-eng-36)
(LA-UR-77-2968; Conf-780110-3) Avail: NTIS HC A03/MF A01

Stack and occupation air samples from plutonium and uranium facilities were analyzed daily. The concentrations of radio-nuclides in air were determined by measuring absolute alpha activities of particulates collected on air sample filter media. The IMPULSE hardware provides for passage of data from the detectors to the computer, and for passage of status and control information from the computer to the detector stations. ERA

N78-26636# Department of Energy, Washington, D. C. Div. of Electric Energy Systems.
ENVIRONMENTAL ASSESSMENT: BATTERY ENERGY STORAGE TEST (BEST) FACILITY, HILLSBOROUGH, SOMERSET COUNTY, NEW JERSEY
Dec. 1977 30 p refs
(Contract EY-76-C-02-2857)
(DOE/EA-0001) Avail: NTIS HC A03/MF A01

The probable impact on the environment which may result from the construction and operation of a National Battery Energy Storage Test (BEST) Facility adjacent to Sunnymeade Road Substation of Public Service Electric and Gas Company in Hillsborough Township, Somerset County, New Jersey, is described. Particular features of facility design that will be included to minimize the environmental impact during operation are also discussed and evaluated. It is concluded that construction and initial operation of the BEST Facility will not have a potentially significant impact on the quality of the human environment. The greatest environmental impact is expected to occur during site preparation and construction of the facility. This assessment is confined to the environmental impact of construction and initial test operations using lead - acid batteries only at this facility and excludes a detailed evaluation of the potential environmental effects of the total battery development program. ERA

N78-26637# California Univ., Livermore. Lawrence Livermore Lab.
PATRIC: A THREE DIMENSIONAL PARTICLE-IN-CELL SEQUENTIAL PUFF CODE FOR MODELING THE TRANSPORT AND DIFFUSION OF ATMOSPHERIC POLLUTANTS
Rolf Lange Jan. 1978 11 p refs
(Contract W-7405-eng-48)
(UCID-17701) Avail: NTIS HC A02/MF A01

A transport and diffusion code designed to calculate the three dimensional distribution of atmospheric pollutants in a given space and time varying flow field is described. The code is based on the particle-in-cell model which the pollutant mass or activity is represented by the spacial distribution of a large number of marker particles. The code is capable of computing instantaneous or time-integrated air concentrations and deposition for a variety of instantaneous or continuous sources, including inert and radioactive materials. ERA

N78-26638# Arizona Univ., Tucson. Analytical Center.
IDENTIFICATION AND ANALYSIS OF URBAN AIR QUALITY PATTERNS Final Report
J. L. Moyers Dec. 1977 174 p refs
(EPRI Proj. 438-1)
(EPRI-EA-487) HC A08/MF A01

A research program of sampling, analysis and evaluation of atmospheric trace components was established in and around Tucson, Arizona in order to identify relationships between atmospheric physical and chemical parameters and air quality conditions. Large particle airborne soil or crustal materials were found to dominate the particulate population in both the urban and rural southern Arizona atmosphere with over a dozen of the measured species directly attributable to these sources. Nonsoil species in general appear to be well mixed and contained predominantly in the small particle population. This suggests that these species are generated by gas to particle conversion processes and distant or diffuse anthropogenic and natural sources. ERA

N78-26639# Stanford Univ., Calif. Dept. of Statistics.
ESTIMATION OF SPATIAL DISTRIBUTIONS FROM POINT SOURCES WITH APPLICATION TO AIR POLLUTION MEASUREMENT
Paul Switzer 1 Jul. 1977 21 p refs Sponsored in part by the Rockefeller Found., Sloan Found., EPA, NSF, and the SIAM Inst. for Math. and Soc.
(Contract EY-76-S-02-2874)
(COO-2874-20; TR-9) Avail: NTIS HC A02/MF A01

A class of weighted estimators of a stationary distribution function is introduced which exploits correlation structure in the data as frequently found in air quality measurements. The nature of these weighted estimates is examined for several simple cases, in particular for spatially clustered measurements where the advantage over the usual empirical distribution function seems most pronounced. An illustration is presented using total suspended particulate concentrations from a 14 station monitoring network. The class of weighted estimators is also proposed for the related problem of estimating the actual realization of a spatial distribution function separately at each fixed time period. ERA

N78-26640# Science Applications, Inc., San Diego, Calif.
RADIOACTIVE AIRBORNE EFFLUENT MEASUREMENT AND MONITORING SURVEY OF REPROCESSING AND WASTE TREATMENT FACILITIES
R. B. Hower, B. Hekkala, and D. T. Pence Sep. 1977 97 p refs
(Contract EY-76-S-02-3049)
(COO-3049-9) Avail: NTIS HC A05/MF A01

The installed and planned sampling and monitoring systems for several ERDA and commercial nuclear fuel reprocessing and high-level waste solidification facilities are described. Source terms, estimated concentrations, and probable monitoring requirements for commercial facilities are presented and discussed. The state-of-the-art technology for reprocessing and waste solidification sampling and monitoring is described and present

limitations discussed. On-going advanced sampling and monitoring development programs are presented and discussed, and additional development needs identified. Recommendations are made for research and development in the areas of alarm monitoring, continuous monitors, and instrument reliability. ERA

N78-26641# California Univ., Livermore. Lawrence Livermore Lab.
AUTOMATION OF THE NATIONAL WATER QUALITY LABORATORIES
H. S. Ames and W. F. Morris 30 Jun. 1977 44 p refs
(Contract W-7405-eng-48)
(UCRL-52295-Pt-2) Avail: NTIS HC A03/MF A01

A three-computer system is proposed for the two National Water Quality (NWQ) laboratories. In each laboratory, two computers will service on-line automated instrumentation and off-line data entry. The third computer will handle sample data management and other functions required to log in samples, assign analyses, store results, and generate sample analysis reports. The design also includes backup features to preserve accumulated sample data and provide continued laboratory operations in the event of component failure. Hardware and software configurations as well as projected system performance and utilization are presented. ERA

N78-26642# Argonne National Lab., Ill.
IMPLICATIONS OF THE 1977 CLEAN AIR ACT AMENDMENTS FOR ENERGY RESEARCH AND DEVELOPMENT
D. B. Garvey, S. L. Kung, D. G. Streets, and G. Leppert 1977 9 p refs Presented at 5th Natl. Conf. on Energy and the Environment, Cincinnati, Ohio, 31 Oct. 1977
(Contract W-31-109-eng-38)
(CONF-7710101-2) Avail: NTIS HC A02/MF A01

The Clean Air Act Amendments of 1977 establish Federal environmental policy governing industrial development in all areas of the country. Some impacts of the legislation on energy development will be to increase the incentives for research on technologies that are inherently less polluting and on improved emission control; to accelerate the rate at which technologies with reduced emissions or with emission control advantages become economical; and to expand the role of conservation measures to reduce energy demand. The legislation will have an impact on the siting and scale of future energy facilities, on control technology requirements, and on the cost-effectiveness and relative attractiveness of various technologies to utilities and other industries. ERA

N78-26643# Addis Translations International, Portola Valley, Calif.
CORRELATIONS BETWEEN THE OUTER DIMENSIONS OF AGGREGATES AND THEIR AERODYNAMIC DIAMETER
W. Walkenhorst and W. Coenen Oct. 1977 16 p refs Transl. into ENGLISH from Staub (West Ger.), v. 37, no. 3, 1977 p 106-107 Prepared for Battelle Pacific Northwest Labs., Richland, Wash.
(BNWL-tr-270) Avail: NTIS HC A02/MF A01

For the case of cross-linked fibrous aggregates, it is shown experimentally in models tests that a simple relationship exists between the aerodynamic diameter, the outer diameter, and the apparent density of the aggregate. The results obtained with model particles sedimenting in a liquid are also applicable to airborne particles. This explains the low sedimentation rate of such aggregates, which must be classified as respirable dust even though their outer dimensions are 30 to 50 microns. If the aerodynamic and outer diameter of an aggregate are known, the apparent density can be determined. If the substance density is known, it is then possible to determine the dynamic shape factor as well. ERA

N78-26644# Chemical Lab. RVO-TNO, Rijswikj (Netherlands).
DISPERSION AND ANALYSIS OF METHANE IN THE ATMOSPHERE
C. J. P. vanBuijtenen, A. Verweij, and H. L. Boter Sep. 1976 24 p refs In DUTCH; ENGLISH summary
(CL-1976-16; TDCK-68902) Avail: NTIS HC A02/MF A01

As part of the project assessing the hazards involved in the transport and handling of liquefied natural gas (LNG-project) the dispersion of methane gas clouds in the atmosphere was studied. Calculations for an instantaneous, continuous, and time-dependent source were made. Starting from Pasquill's method, and taking into account the source dimensions, the amount of gas in the explosive region (5 to 15% v/v) was calculated. For an instantaneous cloud this amount shows a maximum of approximately 50% irrespective of the source length and meteorological conditions. Special attention was paid to the calculation of the safety distance for a quasiinstantaneous spill on the sea. For this case the behavior of the cloud at the source was numerically simulated. For a 25,000 cubic meter spill of LNG this leads to a distance where the average concentration is half the lower flammability limit of approx. 20 km under unfavorable meteorological conditions and a 7 km under favorable meteorological conditions. The possibilities of the continuous and discontinuous measurement of methane concentrations were investigated. A device was built to generate 0.5 to 50% concentrations of methane in air. The accuracy of the concentrations was checked with infrared spectroscopy. The performance of a commercially available combustible gas detector to measure the methane concentration continuously and the use of gas chromatography as a discontinuous method were investigated. Author (ESA)

N78-26645# Resources Conservation Co., Renton, Wash.
EFFECTIVE CONTROL OF SECONDARY WATER POLLUTION FROM FLUE GAS DESULFURIZATION SYSTEMS Final Report, Jul. 1976 - May 1977
Lanny D. Weimer Sep. 1977 70 p refs
(Contract EPA-68-02-2171)
(PB-278373/6; EPA-600/7-77-106) Avail: NTIS HC A04/MF A01 CSCL 07A

A vertical-tube, falling-film, vapor-compression evaporator to concentrate waste water from a flue gas desulfurization process is discussed. Tests showed that waste water from the FGD process can be concentrated up to 140 times and with recovery of more than 99% to the waste stream as high quality water. Two series of tests were conducted: one with a 25 gpd bench model evaporator; the other with a 6000 gpd pilot size evaporator. Process conditions were identified and verified for scale free operation. A conceptual design and economic study of a full size treatment facility showed that capital costs will range from $5110 to $8706/1000 gpd of waste water processed, depending on system capacity. GRA

N78-26646# TRW, Inc., Redondo Beach, Calif.
ENVIRONMENTAL ASSESSMENT OF HIGH-BTU GASIFICATION Annual Report, May - Oct. 1977
M. Ghassemi and C. Murray Feb. 1978 87 p refs
(Contract EPA-68-02-2635)
(PB-278175/5; EPA-600/7-78-025) Avail: NTIS HC A05/MF A01 CSCL 07A

Environmental impacts are assessed that are associated with technologies for converting coal to high-Btu gaseous fuel and to identify control technologies required to reduce or eliminate adverse environmental impacts associated with commercial operation. The program consists of: evaluating existing processes and environmental data; acquiring supplementary data through sampling and analyzing process waste streams; and environmental assessment and process engineering support studies. A modular approach was chosen for analyzing and presenting data on gasification, gas treatment, pollution control, and integrated facilities. Draft gasification data sheets were prepared for some of the processes considered. GRA

N78-26647# Environmental Protection Agency, Research Triangle Park, N.C. Emission Standards and Engineering Div.
STANDARDS SUPPORT AND ENVIRONMENTAL IMPACT STATEMENT. VOLUME 2: PROMULGATED STANDARDS OF PERFORMANCE FOR KRAFT PULP MILLS Final Report
Dec. 1977 50 p refs
(PB-278160/7; EPA-450/2-76-014-Vol-2) Avail: NTIS HC A03/MF A01 CSCL 13B

Standards of performance for the control of emissions of total reduced sulfur (TRS) and particulate matter from new and modified kraft pulp mills are being promulgated under the authority of section 3 of the Clean Air Act. TRS emissions from kraft pulp mills are extremely odorous, and there are numerous instances of poorly controlled mills creating public odor problems. The

promulgated standards will prevent odor problems from most newly constructed kraft pulp mills, except in the immediate vicinity of the mills on occasions when meterological conditions produce downwash of stack plumes. GRA

N78-26648# Environmental Protection Agency, Research Triangle Park, N.C. Emissions Standards and Engineering Div.
STANDARDS SUPPORT AND ENVIRONMENTAL IMPACT STATEMENT. VOLUME 2: PROMULGATED STANDARDS OF PERFORMANCE FOR PETROLEUM REFINERY SULFUR RECOVERY PLANTS
Jan. 1978 39 p
(PB-278163/1; EPA-450/2-76-016-Vol-2) Avail: NTIS HC A03/MF A01 CSCL 13B

A national emission standard for sulfur dioxide and reduced sulfur compounds was proposed under authority of section 3 of the Clean Air Act. The intent of the standard was to minimize reduced sulfur and sulfur dioxide emissions from refinery sulfur recovery plants to the level attainable with best available control technology. Twenty-one comment letters were received from the petroleum industry, state and local air pollution control agencies, and other federal agencies. As a result of these comments, changes were made in the promulgated standard. The major change is an exemption from the standard for sulfur recovery plants of 20 long tons per day or less associated with a small petroleum refinery. GRA

N78-26649# Environmental Protection Agency, Research Triangle Park, N.C. Office of Air Quality Planning and Standards.
CONTROL OF VOLATILE ORGANIC EMISSIONS FROM EXISTING STATIONARY SOURCES. VOLUME 3: SURFACE COATING OF METAL FURNITURE
Dec. 1977 66 p refs
(PB-278257/1; EPA-450/2-77-032-Vol-3; OAQPS-1.2-086-Vol-3) Avail: NTIS HC A04/MF A01 CSCL 13B

Regulations to limit volatile organic compound emissions from the coating operations of metal furniture industry were developed. Specific topics discussed include the following: sources and types of emissions; applicable systems of emission reduction; cost analysis; adverse and beneficial effects of applying technology; monitoring techniques and enforcement aspects. GRA

N78-26650# Environmental Protection Agency, Research Triangle Park, N.C. Office of Air Quality Planning and Standards.
CONTROL OF VOLATILE ORGANIC EMISSIONS FROM EXISTING STATIONARY SOURCES. VOLUME 4: SURFACE COATING FOR INSULATION OF MAGNET WIRE
Dec. 1977 44 p refs
(PB-278258/9; EPA-450/2-77-033-Vol-4; OAQPS-1.2-087-Vol-4) Avail: NTIS HC A03/MF A01 CSCL 13B

Regulations to limit emissions of volatile organic compounds from magnet wire coating operations were developed. Coating operations and control technology are described. Specific topics discussed include the following: sources and types of emissions; Applicable systems of emission reduction; cost analysis; adverse and beneficial effects of applying technology; monitoring techniques and enforcement aspects. GRA

N78-26651# Environmental Protection Agency, Research Triangle Park, N.C. Office of Air Quality Planning and Standards.
CONTROL OF VOLATILE ORGANIC EMISSIONS FROM EXISTING STATIONARY SOURCES. VOLUME 5: SURFACE COATING OF LARGE APPLIANCES
Dec. 1977 71 p refs
(PB-278259/7; EPA-450/2-77-034-Vol-5; OAQPS-1.2-088-Vol-5) Avail: NTIS HC A04/MF A01 CSCL 13B

Regulations to limit emissions of volatile organic compounds (VOC) from the coating operations of the large appliance industry were developed. Methods are given by which VOC emissions can be reduced in this industry, and the monitoring and enforcement aspects are described. GRA

N78-26652# California Univ., Los Angeles. Water Resources Center.
AN ECONOMIC ANALYSIS OF OPTIMAL INVESTMENT SCHEDULING FOR SALINITY CONTROL IN THE COLORADO RIVER
Donald Erlenkotter and Charles R. Ssherer (Calif. Univ., Berkeley)
Dec. 1977 277 p refs
(OWRT Proj. B-170-CAL(5))
(PB-278328/0; UCAL-WRC-W-474) Avail: NTIS HC A13/MF A01 CSCL 13B

Sources of salinity, early modeling efforts, selected legal institutional factors and recent salinity control plans were reviewed. The planning model developed includes the relevant detail of deterministic simulation models for the Colorado and incorporates estimates of economic damages and project costs that may be drawn from other mathematical programming models for agricultural areas and salinity control sites. The model serves best as an information system for exploring the effects of cost-minimizing plans of different assumptions and data variations. GRA

N78-26653# Rutgers - The State Univ., New Brunswick, N. J. Water Resources Research Inst.
THE PETROLEUM INDUSTRY IN THE DELAWARE ESTUARY Report of Work Completed, 1974 - 1976
Ruth Patrick Jan. 1977 450 p
(Grant NSF ENV-74-14810-A03)
(PB-277962/7; NSF/RA-770429) Avail: NTIS HC A19/MF A01 CSCL 13B

A comprehensive evaluation is presented of all of the sources of petroleum in the Delaware Estuary, including the finding that urban runoff and other unrecorded sources constitute a major part of the total load. Investigations of toxicity of petroleum and its products and derivatives to fish, shellfish, and other organisms has revealed that toxicity to most, but not all, immature organisms is greater than that to adults, that petroleum on sediments is much more toxic to oysters than when it is dissolved in the water column, and that chronic and life cycle studies show very much greater toxicity than the acute bioassay tests which are usually relied upon. The study shows that ultraviolet irradiation of no. 2 fuel oil and Iranian crude greatly increases their toxicity. GRA

N78-26654# Hittman Associates, Inc., Columbia, Md.
ENVIRONMENTAL ASSESSMENT OF COAL LIQUEFACTION Annual Report, Jul. 1976 - Sep. 1977
Ken T. Budden and Werner H. Zieger Feb. 1978 202 p
(Contract EPA-68-02-2162)
(PB-278333/0; EPA-600/7-78-019) Avail: NTIS HC A10/MF A01 CSCL 21D

Environmental aspects of 14 of the most prominent coal liquefaction systems, in terms of background, process description, major operations, input and output streams, status, and schedules of system development are given. GRA

N78-26655# Environmental Protection Agency, Research Triangle Park, N.C. Office of Air Quality Planning and Standards.
DRAFT GUIDELINE DOCUMENT: CONTROL OF TRS EMISSIONS FROM EXISTING KRAFT PULP MILLS
Don R. Goodwin Jan. 1978 210 p refs
(PB-278135/9; EPA-450/2-78-003A; OAQPS-1.2-091) Avail: NTIS HC A10/MF A01 CSCL 13B

Guidelines to aid the states in their preparation of plans for the control of emissions of total reduced sulfur (TRS) from existing kraft pulp mills were being proposed under the authority of section 111 (d) of the Clean Air Act. TRS emissions from kraft pulp mills are extremely odorous, and there are numerous instances of poorly controlled mills creating public odor problems. Adoption of the proposed emission guidelines by the states would result in an overall reduction of about 80 percent in nationwide TRS emissions from kraft pulp mills. GRA

N78-26656# Western Washington State Coll., Bellingham. Dept. of Geography and Regional Planning.
THE EFFECTS OF WOOD DEBRIS AND DRIFT LOGS ON ESTUARINE BEACHES OF NORTHERN PUGET SOUND Completion Report

Thomas A. Terich and Scott Milne 1 Dec. 1977 74 p refs (OWRT Proj. A-089-WASH(1))
(PB-277736/5; W78-04103) Avail: NTIS HC A04/MF A01 CSCL 13B

The effects wood debris have on beaches particularly erosion and deposition was studied. Drift logs exhibited seasonal profile changes. Log masses were packed in greater densities and higher on the beach berm in the winter than in the summer, reflecting higher wave energies. Concentrations of drift logs stabilized beaches by capturing beach sediment and shielding the shore from wave attack. GRA

N78-26657# Midwest Research Inst., Kansas City, Mo.
EVALUATION OF SULFATE-BEARING WASTE MATERIAL FROM FLUIDIZED BED COMBUSTION OF COALS FOR SOIL STABILIZATION Final Report
J. W. Nebgen, J. G. Edwards, and D. Conway Sep. 1977 70 p refs
(Contracts DOT-FH-11-8515; E(49-18)-2491)
(PB-278031/0; FHWA-RD-77-136) Avail: NTIS HC A04/MF A01 CSCL 13B

The effects of spent bed material from the fluidized bed combustion of coal in the physical and strength properties of selected finegrained soils were evaluated. The spent bed material is a mixture of time and calcium sulfate obtained by a process from which pulverized coal is burned in a fluid bed of finely ground calcitic or dolomitic limestone. GRA

N78-26658# Massachusetts Inst. of Tech., Cambridge. Energy Lab.
REGULATING THE AUTOMOBILE Progress Report, Sep. 1975 - Aug. 1977
John B. Heywood, Henry D. Jacoby, Lawrence H. Linden, Howard Margolis, and David Iverach Nov. 1977 288 p refs
(Grant NSF OEP-76-00284)
(PB-278123/5; MIT-EL-77-007; NSF/PRA-7600284/1/8) Avail: NTIS HC A13/MF A01 CSCL 13B

Analyses aimed at clarifying the nature of the American system of automotive regulation, its impact, and the reasons for its structure, are presented. Safety, fuel economy, emissions regulation, ambient air quality, fuel economy standards, and political choices between standards and taxes for controlling automotive emissions were explored. GRA

N78-26659# Colorado Univ., Boulder.
EXAMINATION OF THE MULTIREGION MODEL DEVELOPED AT OAK RIDGE NATIONAL LABORATORY Final Report
R. W. Duea, Jr., C. Johnson, and J. O. Frendewey, Jr. 15 Oct. 1977 40 p ref
(Grant NSF AEN-76-17062)
(PB-277913/0; NSF/RA-770370) Avail: NTIS HC A03/MF A01 CSCL 13B

Multiregion is a simulation forecasting model that makes population, labor force and employment projections for each of the 173 BEA areas. The model explicitly deals with some of the interregional effects that result from changing regional conditions. Each region is treated as a labor-market, and the underlying assumption of the model is that future locations of population and employment are influenced strongly by labor-market conditions. GRA

N78-26660# Environmental Protection Agency, Research Triangle Park, N.C. Office of Air and Waste Management.
CONTROL OF VOLATILE ORGANIC COMPOUNDS FROM USE OF CUTBACK ASPHALT
David W. Karkwordt Dec. 1977 19 p refs
(PB-278185/4; EPA-450/2-77-037; OAOPS-1.2-090) Avail: NTIS HC A02/MF A01 CSCL 13B

The control of volatile organic compounds from paving asphalts liquefied with petroleum distillate was investigated. The recommended control technology consists of the substitution of emulsions for cutback asphalt. GRA

N78-26661# Technology Service Corp., Santa Monica, Calif.
VERIFICATION OF THE ISOPLETH METHOD FOR RELATING PHOTOCHEMICAL OXIDANT TO PRECURSOR Final Report
J. Trijonis and D. Hunsaker Feb. 1978 124 p refs
(Contract EPA-68-02-2299)
(PB-278196/1; EPA-600/3-78-019) Avail: NTIS HC A06/MF A01 CSCL 13B

Historical trend data for oxidant concentrations in the Los Angeles region were used to check the isopleth method that was proposed as a replacement for the Appendix J method for relating oxidant to non-methane hydrocarbon (NMHC) and nitrogen oxide (NOx) precursors. Using the median 6-9 AM NMHC/NOx ratio measured during the summer as input to the isopleth model, significant discrepancies were found between the isopleth predictions and actual oxidant trends. GRA

N78-26662# National Academy of Sciences - National Research Council, Washington, D. C. Committee on Medical and Biologic Effects of Environmental Pollutants.
AMMONIA
Nov. 1977 712 p refs
(Contract EPA-68-02-1226)
(PB-278182/1; EPA-600/1-77-054) Avail: NTIS HC A99/MF A01 CSCL 06T

Available information on ammonia as it relates to its effects on man and his environment is presented. Ammonia is a ubiquitous substance and is known widely as a household cleaning agent and as a fertilizer. It plays an important role in the nitrogen cycle, in the life processes, and in the death processes. It is both a friendly molecule and a hazardous one. Discussed are: its physical and chemical properties; the practical methods of measuring it; and the effects of its presence in the environment on man, animals, plants, materials, and the ecology of the environment. GRA

N78-26663# Council on Environmental Quality, Washington, D.C.
ENVIRONMENTAL ACTIVITIES IN 1977 Status Report
Jan. 1978 20 p
(PB-278268/8) Avail: NTIS HC A02/MF A01 CSCL 05D

New environmental legislation, agreements, and policies; policy reform in process; and proposals awaiting congressional action are reviewed. GRA

N78-26664# Environmental Protection Agency, Research Triangle Park, N.C.
USES, LIMITATIONS AND TECHNICAL BASIS OF PROCEDURES FOR QUANTIFYING RELATIONSHIPS BETWEEN PHOTOCHEMICAL OXIDANTS AND PRECURSORS Office of Air Quality Planning and Standards.
Nov. 1977 120 p refs
(PB-278142/5; EPA-450/2-77-021a) Avail: NTIS HC A06/MF A01 CSCL 04A

Approaches for relating ozone to non-methane hydrocarbon and oxides of nitrogen controls are discussed. Procedures are only applicable in addressing the oxidant problem in urban areas, and include use of Eulerian and Lagrangian photochemical dispersion models, a new approach called the Empirical Kinetic Modeling Approach, proportional rollback and statistical approaches. Long range transport of ozone/precursors is discussed. It was concluded that ozone transported above the surface-based nocturnal inversion layer is likely to be the facet of transport exhibiting the greatest impact on maximum ozone levels in urban areas. GRA

N78-26665# Environmental Sciences Research Lab., Research Triangle Park, N.C. Office of Research and Development.
A PROLONGED, LARGE SCALE, OFF-SEASON PHOTOCHEMICAL OXIDANT EPISODE Inhouse Report, Mar. - Dec. 1977
Gerard A. DeMarrais Feb. 1978 41 p refs
(PB-278183/9; EPA-600/4-78-014) Avail: NTIS HC A03/MF A01 CSCL 04A

Oxidant concentrations exceeding 160 microgram/cu were observed. Because this was a violation of the air quality standard at a time when relatively low concentrations were normally anticipated, the meteorological conditions associated with this large scale episode were evaluated. The episode was associated with very slow air movement, slightly elevated temperatures, abundant solar radiation, limited vertical mixing at the coast,

and vertical mixing varying from negligible at night to relatively deep in the daytime at inland sites. GRA

N78-26666# Environmental Sciences Research Lab., Research Triangle Park, N.C. Meteorology and Assessment Div.
THE 1974 OZONE EPISODE IN THE BALTIMORE-TO-RICHMOND CORRIDOR Inhouse Report, Aug. 1976 - Aug. 1977
Gerard A. DeMarrais Feb. 1978 39 p refs
(PB-278190/4; EPA-600/4-78-016) Avail: NTIS HC A03/MF A01 CSCL 04A

The investigation revealed: (1) the period with high ozone concentrations was one when synoptic scale stagnation at the surface and aloft prevailed most of the time together with high temperatures and abundant solar radiation; and, (2) that (3) the Richmond-to-Baltimore corridor was at the southern and eastern periphery of a large area in the industrial eastern United States which had high ozone concentrations, and (4) many of the distant potential source areas implicated in the trajectory analyses observed high ozone concentration. GRA

N78-26667# Wyoming Univ., Laramie. College of Law.
COMMENTS: WATER LAW-CESSATION OF RETURN FLOW AS A MEANS OF COMPLYING WITH POLLUTION CONTROL LAWS
Robert G. Berger 1977 28 p refs
(Contract DI-14-34-0001-7108; OWRT Proj. A-023-WYO(1)) (PB-278324/9; W78-04815) Avail: NTIS HC A03/MF A01 CSCL 05D

Social, legal, and economic policies in regard to the creation and continuation of the total containment water quality control system are examined. Discussed is whether the intentional disposal of water by evaporation incident to industrial or municipal uses is a beneficial use for which water may be appropriated. The relative rights of the junior appropriator and the no-discharge user are considered when both depend directly or indirectly on return flow to satisfy their appropriations. Finally, an economic analysis of the total containment system is made. The denial is based on the principal that the costs of a total containment system should be absorbed by the pollutor and consumer who benefit from operations causing pollution. GRA

N78-26668# National Bureau of Standards, Washington, D. C. Inst. for Materials Research.
THE NATIONAL ENVIRONMENTAL SPECIMEN BANK. PROCEEDINGS OF THE JOINT EPA/NBS WORKSHOP ON RECOMMENDATIONS AND CONCLUSIONS OF THE NATIONAL ENVIRONMENTAL SPECIMEN BANK
Harry L. Rook, ed. and George M. Goldstein, ed. (Health Effects Res. Lab., Research Triangle Park, N. Carolina) Feb. 1978 62 p refs Workshop held at Gaithersburg, Md., 19-20 Aug. 1976
(Contract EPA-IAG-D4-0568)
(PB-277682/1; NBS-SP-501; LC-78-682) Avail: NTIS HC A04/MF A01 CSCL 06F

The workshop consisted of a review session where past considerations were discussed; a technical session where recent analytical research relevant to the sample bank was abstracted and discussed; and a planning session where planning and design of a prototype banking systems was outlined. The workshop concluded that with the ever increasing influx of new man-made substances into our ecosystem, that a formalized, systematic approach is needed to assess the environmental impact of these substances on a national as well as an international level. GRA

46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation*.

N78-26669 Brown Univ., Providence, R. I.
LOCALIZATION OF DEFORMATION, BRITTLE ROCK FAILURE, AND A MODEL FOR THE INCEPTION OF EARTH FAULTING Ph.D. Thesis
John Walter Rudnicki 1977 129 p
Avail: Univ. Microfilms Order No. 7809089

The consequences for processes which give rise to earthquakes were evaluated in terms of a specific model for earth faulting. The general theory of localization of deformation was examined and was applied to examine the effect of stress-induced anisotropy on a model of brittle rock failure as the localization of deformation. Dissert. Abstr.

N78-26670 Colorado School of Mines, Golden.
FREQUENCY DOMAIN AND TIME DOMAIN SOLUTIONS IN THE MAGNETO-TELLURIC METHOD Ph.D. Thesis
Ulrich Schimschal 1977 105 p
Avail: Univ. Microfilms Order No. 7802788

A controlled magneto-telluric, depth sounding technique was developed in the time domain by way of the theory of eigen-functions. The use of Maxwell's equations led to a differential equation that was solved by separation of variables. This in turn leads to an eigenvalue problem. Both harmonic and nonharmonic solutions were formulated in terms of eigenvalues. The harmonic solution gave a result that was dependent on frequency. A computer program was developed for the multilayered case of horizontal, isotropic, and homogeneous layers above an infinite half space, model curves of one and two layers thickness, and permeability. The nonharmonic solution resulted in an expression that gave the time derivative of the wave impedance as a function of time. Dissert. Abstr.

N78-26671 Stanford Univ., Calif.
SHEET STRUCTURE IN ROCK AND SOME RELATED PROBLEMS IN ROCK MECHANICS Ph.D. Thesis
Gary Reed Holzhausen 1978 532 p
Avail: Univ. Microfilms Order No. 7808800

Most of the problems pertain to the mechanics of fracturing of rock. The geometrical characteristics and mechanical origins of sheet structure, or large-scale exfoliation, are discussed. Sheet structure is the division of massive, relatively homogeneous rocks into lenses, plates, or sheets that approximately parallel the earth's surface. Sheet fractures, which separate the plates, are characterized by surface markings that resemble those formed during the brittle fracture of metals, glass, and ceramics. Sheet fractures appear to form exclusively where the rock is under high compressive stresses, up to about 350 bars, parallel to a free surface. This compression may result from contemporary tectonic forces, unloading of a rock mass by erosion of overburden, or thermal effects produced by insolation. Thermal stresses, however, are restricted to depths within a few meters of the exposed rock surface. Dissert. Abstr.

N78-26672 Pittsburgh Univ., Pa.
CONTINUOUS MEASUREMENTS OF THE NATURAL REMANENT MAGNETIZATION OF SEDIMENTS FROM LAKE MICHIGAN AND LAKE TAHOE Ph.D. Thesis
Richard Edward Dodson 1977 228 p
Avail: Univ. Microfilms Order No. 7809550

Continuous measurements of the natural remanent magnetization (NRM) of a series of eleven sediment cores from southern Lake Michigan and a series of three cores from Lake Tahoe were made, using a three axis cryogenic magnetometer. The continuous measurement of long cores has two significant advantages over conventional measurements of individual samples taken from such cores. First, the time required for measuring the NRM of an entire core was reduced from a period of weeks or months to one of a few hours. Secondly, misorientation errors and errors sediment disturbance in the extraction of individual samples were avoided. The minimization of these errors was especially critical in the analysis of secular variation records obtained from wet, unconsolidated sediment cores.
Dissert. Abstr.

N78-26673 Texas Univ., Austin.
AN IMPLICATION OF THE HILBERT TRANSFORM TO THE MAGNETOTELLURIC METHOD Ph.D. Thesis
John Elmo Boehl 1977 107 p
Avail: Univ. Microfilms Order No. 78-07264

Noise is inevitably encountered when the tensor magnetotelluric (MT) method is used for geophysical sounding purposes. It is shown that, for many cases, the magnetitudes of the impedance

elements are biased by noise on the MT data channels, whereas the phases of these elements are unbiased. A practical method for deriving or smoothing the amplitude data by phase information is presented in this dissertation. The means for accomplishing this is based on the Hilbert Transform operation on minimum phase MT impedance functions. The formulas for the use of this method are developed, and some practical considerations are given for the implementation of the phase smoothing process. A theoretical model with and without synthetic noise is analyzed through this process to illustrate the validity of the technique. Also shown are several examples of results from this process as applied to actual tensor magnetotelluric impedance data.
Dissert. Abstr.

N78-26674 Cornell Univ., Ithaca, N. Y.
SEISMOTECTONICS IN INTRAPLATE AND INTERPLATE REGIONS: EASTERN NORTH AMERICA, EASTERN TAIWAN, CHINA, AND THE NEW HEBRIDES Ph.D. Thesis
James Earl York, III 1977 162 p
Avail: Univ. Microfilms Order No. 7807804

Three studies of seismotectonics, in eastern North America, eastern Taiwan, and the whole of China, focus on the subject of using observations of quaternary faulting and a long record of seismicity to understand the tectonics and to determine levels of seismic hazard. A fourth study, in the New Hebrides, supplements data on large earthquakes with data on microearthquakes. Observations of Cretaceous and Cenozoic faulting in eastern North America provide evidence of modest intraplate tectonic activity in this region. Thrust and gravity faults are found; strike-slip movement is not demonstrable but could have occurred in some cases. Observed Cretaceous and Cenozoic displacements range from about 1 mm to several tens of meters. The faults are found in the central Mississippi River Valley, the southeastern United States, the northeastern United States, and eastern Canada.
Dissert. Abstr.

N78-26675 Pennsylvania State Univ., University Park.
PROCESSES, RESPONSES, AND RESULTING STRATIGRAPHIC SEQUENCES OF BARRIER ISLAND TIDAL INLETS AS DEDUCED FROM ASSAWOMAN INLET, VIRGINIA Ph.D. Thesis
Rudy Lynn Slingerland 1977 456 p
Avail: Univ. Microfilms Order No. 7808426

A process-response analysis of Assawoman Inlet, Va., representative of barrier island inlets on coasts with relatively high wave energy and low sediment supply, provided an alternative to depositional models for laterally migrating inlets. The new channel intersection model was deduced from 10 deep cores, numerous shallow cores, four process-response mathematical models, aerial photographs, and observations of textures, bedforms, and larger scale morphologic changes over a year. In this model, inlet facies were not continuous swath or sheet sands produced by inlet lateral migration, but were discontinuous and sinuous sandbodies following old back barrier channels. This occurred because low alongshore sediment supply inhibits spit development and caused back barrier peats to be exposed in the inlet throat. Both make lateral migration difficult and act to keep the inlet located at the intersection of the retreating coastline and major back channels.
Dissert. Abstr.

N78-26676# Magnetic Observatory, Hermanus (South Africa).
STUDIES IN IONOSPHERIC RAY TRACING M.S. Thesis - Rhodes Univ., Mar. 1977
Sheridan Lambert Apr. 1978 116 p refs
(R-MAG-5/17) Avail: NTIS HC A06/MF A01

The use of ray tracing in the analysis of certain daytime ionograms is discussed. A computer program was developed and used to trace rays in the frequency range 1 - 30 MHz. Vertical, short distance oblique, and long distance oblique ionograms were synthesized from the results. These were compared with vertical and oblique ionograms. Ray paths were calculated and related in detail to the models of the ionosphere and the geomagnetic field.
Author

N78-26677*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ESTIMATION OF SNOW TEMPERATURE AND MEAN CRYSTAL RADIUS FROM REMOTE MULTISPECTRAL PASSIVE MICROWAVE MEASUREMENTS
A. T. C. Chang Jun. 1978 15 p refs
(NASA-TP-1251) Avail: NTIS HC A02/MF A01 CSCL 08L

Variation in crystal size and physical temperature of snowfield observations from space give large variations in the microwave brightness temperature. Since the brightness temperature is a function of wavelength, the microwave brightness temperature can be used to extract the snow temperature and mean crystal radius profiles. The Scanning Multichannel Microwave Radiometer (SMMR), to be launched on board the Nimbus-G and Seasat-A spacecraft, will make observations in wavelengths of 0.8, 1.4, 1.7, 2.8, and 4.6 cm. A statistical retrieval method was developed to determine the snowfield temperature profile and mean crystal size by using the scanning multifrequency microwave radiometer on board a spacecraft. The estimated errors for retrieval are approximately 1.5 K for temperature and 0.001 for crystal radius in the presence of 1 K rms noise for each SMMR channel.
Author

N78-26678*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE INFLUENCE OF TORTUOSITY ON THE SPECTRUM OF RADIATION FROM LIGHTNING RETURN STROKES
David M. Levine May 1978 33 p refs
(NASA-TM-79544) Avail: NTIS HC A03/MF A01 CSCL 04A

An investigation was made of the influence of tortuosity on the spectrum of radiation from lightning return strokes. The shape of the spectrum obtained by including effects of tortuosity was in keeping with data: The spectrum had a peak in the correct frequency regime followed by an initial decrease as the inverse of frequency. This spectrum was in better agreement with data than the spectrum predicted by the same model without tortuosity (i.e. the long straight channel), which decays at a rate proportional to 1/v squared.
Author

N78-26679*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GRAVITY ANOMALIES NEAR THE EAST PACIFIC RISE WITH WAVELENGTHS SHORTER THAN 3300 KM RECOVERED FROM GEOS-3/ATS-6 SATELLITE-TO-SATELLITE DOPPLER TRACKING DATA
James G. Marsh, Bruce D. Marsh (Johns Hopkins Univ., Baltimore), Timothy D. Conrad (EG and G Washington Analytical Services, Riverdale, Md.), William T. Wells (EG and G Washington Analytical Services, Riverdale, Md.), and Ronald G. Williamson (EG and G Washington Analytical Services, Riverdale, Md.) Dec. 1977 275 p refs Presented at the 2d Intern. Symp. on the Use of Artificial Satellites for Geodesy and Geodynamics, Lagonissi, Greece, May 1978
(NASA-TM-79553) Avail: NTIS HC A12/MF A01 CSCL 08N

The velocity of the GEOS-3 satellite measured by Doppler as a function of time from the ATS-6 satellite was used to recover gravity anomalies in the region of the East Pacific. The orbit GEOS-3 at an altitude of 840 km was perturbed by spatial changes in Earth's gravitational field. These perturbations were measured via ATS-6 which is in a synchronous orbit at an altitude of about 40,000 km. The range-rate data were reduced using a gravitational field model complete to the 12 degree and order. A simulation of the possible effects causing the remaining range-rate residuals relative to the 12, 12 field shows that in general the dominant effect is the neglect of the higher degree and order coefficients of the gravitational field model.
Author

N78-26680*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
STRUCTURE OF THE MAGNETOPAUSE: OBSERVATIONS AND IMPLICATIONS FOR RECONNECTION
D. H. Fairfield Jun. 1978 42 p refs Presented at the Innsbruck Intern. Symp. on Solar Terrest. Phys., Austria
(NASA-TM-79557) Avail: NTIS HC A03/MF A01 CSCL 04A

The earth's magnetopause is the boundary between a hot tenuous plasma in the magnetosphere and a cooler denser plasma in the magnetosheath. Both of these plasmas contain magnetic fields whose directions are usually different but whose magnitudes are often comparable. Efforts to understand the structure of the magnetosphere were hampered by the variability and complexity of this boundary. Although conclusive direct evidence for a field

component, B sub n across the magnetopause was not found, this lack of evidence may reflect the difficulty in determining B sub n in the presence of magnetopause waves rather than the real absence of this component. Considerable indirect evidence exists for an open magnetosphere, but the importance of the reconnection process thought to produce open field lines was questioned. Author

N78-26681# Lowell Univ. Research Foundation, Mass.
THEORETICAL CALCULATIONS OF H2O LINEWIDTHS AND PRESSURE SHIFTS: COMPARISON OF ANDERSON THEORY WITH QUANTUM MANY-BODY THEORY FOR N2 AND AIR BROADENED LINES
Richard W. Davies and Basil A. Oli Dec. 1977 72 p refs
(Contract F19628-77-C-0053)
(AD-A053249; ULRF-390/CAR; AFGL-TR-78-0001; SR-1) Avail: NTIS HC A03/MF A01 CSCL 04/1

The purpose of this paper is to make specific comparisons of two theoretical methods with available experimental measurements of H2O widths and shifts for the case of N2 (or air) broadening. The earliest calculations of H2O-N2 half widths were carried out by Benedict and Kaplan (BK) using the Anderson-Tsao-Curnutte (ATC) theory of pressure broadening. Considering that only one accurate measurement was available at the time their work was carried out, the theoretical results, with one notable exception, have stood up remarkably well. GRA

N78-26682# Naval Research Lab., Washington, D. C.
THE PHYSICS AND THE CHEMISTRY OF NRL MASTER CODE FOR THE DISTURBED E AND F REGIONS
A. W. Ali Mar. 1978 68 p refs
(AD-A053256; NRL-M-3732) Avail: NTIS HC A04/MF A01 CSCL 04/1

The detailed physics and the chemistry of NRL Master Code for the Deionization Phase of the Disturbed E and F Regions are presented. Important physical processes are delineated and the current reaction rates, incorporated in the Code, are given. Author (GRA)

N78-26683# Utah State Univ., Logan. Space Science Lab.
STUDIES OF THE DISTURBED UPPER ATMOSPHERE UTILIZING ROCKETBORNE INSTRUMENTATION Final Report, 1 Mar. 1974 - 1 Nov. 1977
Kay D. Baker, L. Carl Howlett, Doran J. Baker, and Larry L. Jensen Oct. 1977 61 p refs
(Contract F19628-74-C-0130)
(AD-A053231; AFGL-TR-77-0223) Avail: NTIS HC A04/MF A01 CSCL 04/1

This report contains summaries, with reference to technical reports, describing development and use of fourteen rocket payloads to investigate ionospheric parameters and new techniques of measurement. Additionally, theoretical studies were undertaken in the laboratory to assist in interpretation of measurements. This report details experiments conducted, instrumentation, and results of these efforts. GRA

N78-26684# Ohio State Univ., Columbus. Dept. of Geodetic Science.
RECENT DEVELOPMENTS IN THE GEODETIC BOUNDARY VALUE PROBLEM
Helmut Moritz Dec. 1977 130 p refs
(Contract F19628-77-C-0082; AF Proj. 2309; OSU Proj. 710533)
(AD-A053187; AFGL-TR-78-0002; SR-2) Avail: NTIS HC A07/MF A01 CSCL 08/5

The report reviews progress in the mathematical formulation and treatment of the geodetic boundary-value problem, in particular, the existence and uniqueness theorems of L. Hormander and the gravity space approach due to F. Sanso. The method of Hormander uses a very advanced inverse function theorem of nonlinear functional analysis. Sanso has transformed Molodensky's free boundary-value problem into a fixed boundary-value problem in gravity space, thereby essentially reducing the mathematical complexity. As a linear approximation, the gravity space approach gives identical superior for treating questions of existence and uniqueness of the solution, although it is restricted to the pure gravitational case without centrifugal force. Author (GRA)

N78-26685# Atmospheric Sciences Lab., White Sands Missile Range, N. Mex.
THE 1979 SOLAR ECLIPSE AND VALIDATION OF D-REGION MODELS
Melvin G. Heaps Mar. 1978 43 p refs
(DA Proj. 1L1-62111-AH-71)
(AD-A053312; ERADCOM/ASL-TR-0002) Avail: NTIS HC A03/MF A01 CSCL 04/1

The 26 February 1979 solar eclipse provides an opportunity for controlled experiments to help differentiate among the several processes of D-region ionization. One major concern is whether the sources of ionization are largely solar or predominantly due to particle precipitation. Of equal importance are the electron attachment and detachment processes which determine the free electron densities. Comparisons of current gas-phase ion chemistry calculations with scattered available data show serious discrepancies for electron density variations above 70 km. The inclusion of a new class of reactions involving aerosols or particulates would seem to be indicated. A correct determination of D-region electron densities and electron attachment and detachment processes is necessary for proper utilization of Army communications systems and a better understanding of the effects of nuclear weapons in the middle atmosphere. Author (GRA)

N78-26686# Los Alamos Scientific Lab., N. Mex.
LAGOPEDO: TWO F-REGION IONOSPHERIC DEPLETION EXPERIMENTS
M. B. Pongratz, Gordon Meade Smith, Clair Dexter Sutherland, and John Zinn 1977 5 p Presented at the Ionospheric Effects Symp., Washington, D.C., 24 Jan. 1978 Sponsored by NRL
(Contract W-7405-eng-36)
(LA-UR-77-2743; Conf-780106-1) Avail: NTIS HC A02/MF A01

A significant depletion of ionospheric plasma was produced by a chemical release experiment in the F-layer ionosphere over Hawaii. The results of measurements of the hole produced in the ionospheric plasma are reported. ERA

N78-26687# California Univ., Livermore. Lawrence Livermore Lab.
REEXAMINATION OF POTENTIAL SPACE SHUTTLE EFFECTS ON THE STRATOSPHERE
Donald J. Wuebbles 13 Dec. 1977 9 p refs Sponsored in part by FAA and DOT
(Contract W-7405-eng-48)
(UCID-17689) Avail: NTIS HC A02/MF A01

The potential effects of the space shuttle on stratospheric chemistry were examined. Assuming 60 space shuttle flights per year, a calculated reduction in total ozone of 0.27 percent was derived. This corresponds to a 5 percent increase in stratospheric odd chlorine. ERA

N78-26688# Los Alamos Scientific Lab., N. Mex.
UNDERGROUND STRESS ENGINEERING: THE LIFTING AND STABILIZATION OF UNDERGROUND VOIDS
Stirling A. Colgate, Albert G. Peteschek (N. Mex. Tech., Socorro), Richard V. Browning, and Norman K. Bowers (Ward Fire Dept., Colo.) 1977 27 p refs Presented at the Am. Nucl. Soc. Topical Meeting, Golden, Colo., 12-14 Apr. 1977 Sponsored in part by N. Mex. Inst. of Mining and Tech., N. Mex. Energy Res. and the Bueno Mines, Jamestown, Colo.
(Contract W-7405-eng-36)
(LA-UR-77-844; Conf-770440-4) Avail: NTIS HC A03/MF A01

The theoretical basis of how grout, i.e., concrete, pumped into rock fractures prevents the caving of underground tunnel and cavity roofs is presented. The calculation of how much grout material must be injected to lift a dome and create a useful rubble stope in an underground cavity is also described. ERA

N78-26689# Wisconsin Univ., Madison. Dept. of Metallurgical Engineering.
EFFECT OF PRINCIPAL STRESS MAGNITUDES ON HYDROFRACTURING ORIENTATION Final Report
Bezalel C. Haimson Dec. 1977 20 p refs Prepared for Calif. Univ., Livermore. Lawrence Livermore Lab.
(Contract W-7405-eng-18)
(UCRL-13795) Avail: NTIS HC A02/MF A01

Tests were conducted in Montello granite to verify the effect of the vertical stress magnitude on hydrofracture orientation. It was found that so long as the vertical stress is smaller than the least horizontal compressive stress there is a good probability that the hydrofracture, which initiates vertically at the borehole, will rotate and become horizontal as it extends away. Thirty-one tests were conducted to investigate the effect of the difference (sigma/sub Hmax/ to sigma/sub Hmin/) on the orientation of the hydrofracture. In these tests the vertical stress was kept higher than sigma/sub Hmin/. The results show that hydrofractures are vertical and parallel to sigma/sub Hmin/ so long as sigma/sub Hmax/ to sigma/sub Hmin/ is greater than 75 psi, which arrests to the sensitivity of the hydrofracture direction to the principle of the path of least resistance. ERA

N78-26690# Alaska Univ., Fairbanks. Geophysical Inst.
STUDY OF THE MAGNETIC FIELD ANNIHILATION PROCESS IN THE MAGNETOSPHERE AND SOME APPLICATIONS (ELECTRIC CURRENTS IN THE TRANS-ALASKA PIPELINE INDUCED BY AURORAL ACTIVITY)
Syun-Ichi Akasofu May 1977 13 p refs
(Contract EY-76-S-06-2229-005)
(RLO/2229/T5-7) Avail: NTIS HC A02/MF A01

Experiments were conducted to learn how plasma processes in nature are associated with magnetic energy conversion processes. One experiment was designed to monitor electric currents in the Trans-Alaska pipeline induced by auroral activity and another was to determine the depth of permafrost by observing electric and magnetic fields of audio frequency radio waves generated by the aurora. From the results, it appears that the merging (or reconnection) process is not the conversion of the magnetic field energy in the tail region of the magnetosphere. The magnetic energy release during the initial phase of a magnetospheric substorm seems to arise from a sudden disruption of the electric current across the magnetotail. P.R.A.

N78-26691# Instituto Geografico y Catastral, Madrid (Spain).
TOTAL IONOSPHERIC ELECTRON CONTENT. CALCULATION OF THE M FACTOR [EL CONTENIDO TOTAL DE ELECTRONES EN LA IONOSFERA. CALCULO DEL FACTOR M]
Fernando AranazdelRio 1977 10 p In SPANISH
Avail: NTIS HC A02/MF A01

Programs are described for calculation of the M factor, which appears in the formula for determination of the vertical ionospheric electron content using the Faraday effect on satellite-transmitted radio signals. The factor M is a function of the position of the receiving station and its vertical, the satellite's position as a function of time, and the geomagnetic field intensity and direction in all points of the trajectory satellite transmitter - ground receiver as a function of time. ESA

N78-26692# Laboratorio di Ricerca e Technologia per lo Studio del Plasma nello Spazio, Frascati (Italy).
COMPUTER DATA SIMULATION FOR THE GRAVITATIONAL-WAVE EXPERIMENT
P. Bonifazi and V. Ferrari Dec. 1977 42 p refs
(LPS-77-26) Avail: NTIS HC A03/MF A01

Output data from the gravitational wave experiment of the Weber type were simulated by computer on the basis of the values of the parameters that identify the process at the output of the electronic amplifier. The signal at the output of the electronic circuit was represented as a discrete process sum of the two first-order independent autoregressive processes, that take into account the thermal noise of the bar (Brownian noise) and the one of the electronics'. The parameters which characterize the output process are the Brownian and electronic variances, the relaxation time of the antenna, its resonant frequency pertinent to the first longitudinal mode, the integration time of the phase-sensitive detector (PSD), and the sampling time of the output data that was taken equal to the interaction time. The simulation was realized both in the case in which the reference frequency of the PSD is equal to that of the first longitudinal mode of the bar (absence of beats) and in the case that there is a constant difference between these two frequencies (beats). Author (ESA)

N78-26693# Stockholm Univ. (Sweden). Dept. of Meteorology.
HIGH-ALTITUDE SOUNDINGS OF STRATOSPHERIC OZONE DURING WINTER
Paul Schlyter, Andrew Matthews, and Georg Witt 28 Jul. 1977 30 p refs
(AP-17) Avail: NTIS HC A03/MF A01

As a part of an extensive investigation of minor constituents in the stratosphere and mesosphere at high latitudes at the end of the winter, balloon ozone soundings were performed almost every day during a two-week period between March 4 and March 18, 1975. A brief theoretical outline, presentation of the observation data, and a comparison with total ozone measurements during the campaign period, but also during previous years at the same season are given. Comparison with measurements of ozone at the ground is also made. The ozone data suggest a relation between total ozone and temperature. The shape of the ozone profiles are also related with the circulation pattern. An apparent error in the ozone soundings is discussed, and a tentative correction is made. Author (ESA)

N78-26694# Max-Planck-Institut fuer Physik und Astrophysik, Garching (West Germany). Inst. fuer Extraterrestrische Physik.
A WIDE-ANGLE OPTICS FOR BALLOON OBSERVATION OF ULTRAVIOLET Mg2 EMISSIONS IN THE LOWER IONOSPHERE
L. Haser and A. Valenzuela Dec. 1976 12 p refs
(MPI-PAE/Extraterr-128) Avail: NTIS HC A02/MF A01

A wide angle optics system, based on a fish-eye lens, which meets the specifications of balloon observations of Mg2 emissions near 2800 A in the lower ionosphere is described. The requirements are first outlined followed by design considerations, dimensions of the optical elements and a note on image quality. ESA

N78-26695# Deutsches Geodaetisches Forschungsinstitut, Munich (West Germany).
THE HIGH PRECISION CALCULATION OF ANOMALOUS VERTICAL GRAVITY GRADIENTS Ph. D. Thesis - Tech. Hochschule Darmstadt, West Ger. [DIE BERECHNUNG VON ANOMALEN VERTIKALEN SCHWEREGRADIENTEN HOHER PRAEZISION]
Guenter Hein Bayerische Akad. der Wiss. 1977 119 p refs In GERMAN
(Ser-C/Diss-234; ISBN-3-7696-9290-X) Avail: NTIS HC A06/MF A01

Accurate methods for the calculation of anomalous vertical gravity gradients based on the Molodensky theory are presented. The general solution of the mathematical problem leads to a singular inhomogeneous second order integral equation that can be solved by expansion into series of the Kth power (Molodensky method) or by successive iteration. Various regularization methods (Green, Fredholm) are discussed. For a theoretical earth model with various inclinations test calculations were performed using the Gurkina solution and the general Ostach/Molodensky solution. Practical calculations for the Odenwald as test area were performed. It is shown that calculation of the vertical gradients is possible with an accuracy of + or - 1 (E). ESA

N78-26696# Wyoming Univ., Laramie. Water Resources Research Inst.
SOIL HYDRAULIC PROPERTIES DETERMINED BY INFILTRATION EXPERIMENTS AND SIMULATION
Wayland J. Anderson and Warren G. Hedstrom Nov. 1977 82 p refs
(Contracts DI-14-31-0001-3551; DI-14-31-0001-3851)
(PB-278315/7; SER-70; W78-04812; OWRT-A-007-WYO(1))
Avail: NTIS HC A05/MF A01 CSCL 08M

A test method is reported for determining the water content matric potential relationship and the hydraulic conductivity - matric potential relationship for infiltration into soil. Several infiltration experiments were conducted using soil columns from which infiltration rate-time data, the initial and final water contents, and an estimate of the hydraulic conductivity at the final water content were obtained. Simulation of the infiltration tests was performed by computer using various parameters including the bubbling matric potential, pore size distribution index, transition

values on the theta (h) curve, and the hydraulic conductivity at the final water content in the previously mentioned relationship. GRA

N78-26697# Transport and Road Research Lab., Crowthorne (England).
TRENCH WALLJACK: AN APPARATUS TO MEASURE THE EQUIVALENT ELASTIC MODULUS OF SOIL
G. J. L. Lawrence 1977 20 p refs
(PB-277740/7; TRRL-SUPPLEMENTARY-347) Avail: NTIS HC A02/MF A01 CSCL 08M

The modulus of elasticity of soil can be used to predict the magnitude and distribution of deflections, wall stresses and strains imposed by soil loading on buried pipelines. A trench wall jack is described which can be used to determine the load deformation characteristics of in-situ soil at the side of a trench. Circular plates were loaded against opposite sides of a trench by means of a hydraulic jack. The load and penetration were measured by suitably placed transducers and the output of these transducers was recorded on an X-Y plotting machine. An equivalent modulus of elasticity for the soil are calculated from the results. The apparatus and the testing techniques used are described and the results of the tests carried out with a remolded cohesive soil are given. GRA

N78-26698# Delaware Univ., Newark. Coll. of Marine Studies.
PETROLOGY AND STRATIGRAPHY OF HOLOCENE COASTAL-MARSH DEPOSITS ALONG THE WESTERN SHORE OF DELAWARE BAY
Elizabeth A. Allen 1977 301 p refs
(PB-278893/3; DEL-SG-20-77; NOAA-78020201) Avail: NTIS HC A14/MF A01 CSCL 08G

Seventeen marsh facies and subfacies from temperate-zone marsh deposits along the western shore of Delaware Bay are defined. Subsurface distributions of marsh facies were related to sea-level changes, compaction, shoreline configuration, drainage, sediment supply, and other factors. Stratigraphic sections containing single facies indicates a balance between depositional conditions and relative sea level. Three typical stratigraphic sequences are developed for the Delaware Bay shoreline: broad marsh-continuous barrier sequence, broad marsh-discontinuous barrier sequence, and tidal-river marsh sequence. GRA

N78-26699# New Mexico State Bureau of Mines and Mineral Resources, Socorro.
BIBLIOGRAPHY OF NEW MEXICO GEOLOGY AND MINERAL TECHNOLOGY, 1971-1975
John R. Wright and Judy A. Russell 1977 142 p
(PB-278348/8; BULL-106) Avail: NTIS HC A07/MF A01 CSCL 08G

Items that are generally accessible and contain technical information on geoscience and mineral technology are listed. Papers relating to geographical areas adjoining New Mexico were sometimes included (for example west Texas) particularly where major geologic features straddle the state boundary. Highly generalized articles of only a page or two (for example devoted to the Southwest) were excluded. The few references dated prior to 1971 are included because they were omitted in earlier bibliographies. GRA

47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

N78-26700*# Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.
SATELLITE OBSERVATIONS OF THE ONSET AND GROWTH OF SEVERE LOCAL STORMS
Andrew J. Negri and Thomas H. VonderHaar Dec. 1977 100 p refs
(Grants NsG-5011; NSF ATM-76-21307)
(NASA-CR-157046; AS-Paper-278; CSU-ATSP-278; US-ISSN-0067-0340) Avail: NTIS HC A05/MF A01 CSCL 04B

The mesoscale nature of the forcing and evolution of these storms was investigated, with emphasis on techniques to aid in the early detection of such severe events. In the pre-storm environment (t-4 to t-2 hours), the satellite wind fields were combined with moisture parameters to derive horizontal moisture flux information. Low level moisture convergence was indicative of regions of subsequent severe storm genesis. Dynamic parameters such as boundary layer vorticity production and relative vorticity were also useful prognosticators of subsequent severe activity. Author

N78-26701*# Utah Univ., Salt Lake City. Dept. of Meteorology.
HORIZONTAL EDDY DIFFUSIVITIES IN THE NORTHERN HEMISPHERIC STRATOSPHERE AND LOWER MESOSHPERE
S. K. Kao, R. J. Okrasinski, and N. J. Lordi Jun. 1978 75 p refs
(Contract NAS6-2498)
(NASA-CR-3006) Avail: NTIS HC A04/MF A01 CSCL 04B

Meteorological rocket soundings, representative of low, middle, and high altitudes, are employed with the use of the statistical theory of diffusion, to determine the zonal and meridional component of eddy diffusivity between 30 and 55 km as a function of season, latitude, and altitude. A comparison is also made between annualry-averaged eddy diffusivities above and below 30 km. It is shown that the zonal component of eddy diffusivity is approximately three to five times as large as the meridional component, in most cases. Both components of eddy diffusivity varied greatly with season, latitude, and altitude. Highest eddy diffusivities occurred in the vicinity of the winter westerly jet located near the tropopause and in the stratosphere at 35 km, 40 deg N. Annually, a minimum of eddy diffusivity occurred near 20 km. In most cases, the zonal component of the eddy diffusivity was approximately three to five times as large as the meridional component. The meridional cross-sections of the zonal and meridional components of the eddy diffusivity in the northern hemisphere are presented. Author

N78-26702*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
AN ANALYSIS OF MAXIMUM HORIZONTAL WIND SPEEDS RECORDED SINCE 1961 AT KENNEDY SPACE CENTER, FLORIDA
Margaret B. Alexander May 1978 58 p refs
(NASA-TM-78177) Avail: NTIS HC A04/MF A01 CSCL 04B

Tabulations of maximum horizontal wind speed values are reported that were recorded at the Kennedy Space Center. Maximum wind speeds were recorded during the eight hurricanes which have affected the area--Cleo in August 1964 through Agnes in June 1972. Detailed tabulations and frequency distributions of daily maximum horizontal wind speeds recorded at NASA's 150 m ground tower facility at nine levels from December 1965 through March 1970 are also included. G.G.

N78-26703# Air Force Geophysics Lab., Hanscom AFB, Mass.
NEW CLOUD PHYSICS INSTRUMENTATION REQUIREMENTS Interim Report
Arnold A. Barnes, Jr. Boston Am. Meteorol. Soc. 17 Apr. 1978 7 p Repr. from Preprint Vol., 4th Symp. on Meteorol. Observations and Instrumentation, 10-14 Apr. 1978 p 264-268 Presented at 4th Symp. on Meteorol. Observations and Instrumentation, Denver, 10-14 Apr. 1978
(AD-A053235; AFGL-TR-78-0093) Avail: NTIS HC A02/MF A01 CSCL 04/2

Air Force requirements for in situ cloud physics measurements of crystal habit, particle size distribution, and ice/water content values are reviewed. These areas of deficiency are noted. The first is in and just above the melting zone where there are large clusters of snow and mixed ice and snow. Two instruments developed for the Air Force are being tested to obtain total ice/water measurements through this region. The second deficiency exists in automatic instrumentation for the detection of the largest size particles. These data are needed for determining size spectra cut off. The third deficiency is in the area of measurements in tenuous clouds, and is essentially a sampling volume problem. Author (GRA)

N78-26704# Cornell Univ., Ithaca, N. Y. School of Civil and Environmental Engineering.
THE DETERMINATION OF REGIONAL EVAPOTRANSPIRATION BY MEANS OF STANDARD METEOROLOGICAL DATA
Completion Report
Wilfried H. Brutsaert Nov. 1977 39 p refs
(Contracts DI-14-34-0001-7067; DI-14-31-0001-7068; OWRT Proj. A-068-NY(1))
(PB-278133/4; W78-04372) Avail: NTIS HC A03/MF A01 CSCL 04B

Parameterization of the atmospheric boundary layer to the determination of regional evapotranspiration by means of standard meteorological data was investigated. An analysis was performed of data taken over the ocean during the AMTEX experiments of 1974 and 1975. Bulk transfer relationships were obtained for water vapor and sensible heat in the atmosphere for different interpretations of the thickness scale of the boundary layer. A method was available for the direct use of the similarity formulation in hydrological and related engineering problems, while obviating the need for excessive local calibration. GRA

N78-26705# National Oceanic and Atmospheric Administration, Washington, D. C. Environmental Data Service.
TEMPERATURE AND PRECIPITATION CORRELATIONS WITHIN THE UNITED STATES
Harold L. Crutcher (Natl. Climatic Center, Asheville, N. C.) Feb. 1978 42 p refs
(PB-278831/3; NOAA-TR-EDS-26; NOAA-78022101) Avail: NTIS HC A03/MF A01 CSCL 04B

The relationship of monthly temperature and the occurrence of subsequent precipitation within the United States within two separate time periods, 1906-1948 and 1949-1970 is presented. Few good pattern signals were detected. GRA

48 OCEANOGRAPHY

Includes biological, dynamic and physical oceanography; and marine resources.

N78-26706 Miami Univ., Coral Gables, Fla.
SHEAR FLOW INSTABILITY AS A SOURCE OF INTERNAL WAVES ON THE CONTINENTAL SHELF Ph.D. Thesis
John Jengshyong Tsai 1977 187 p
Avail: Univ. Microfilms Order No. 78-08255

Internal wave packets on the continental shelf were observed from satellite images and via shipboard measurements. Temperature and acoustic echo-sounder measurements show that these are essentially undulatory internal bores perhaps having tidal origin. An instability calculation suggests the source of the undulations is local shear flow instability. A three layer model was constructed, having continuous zero-order density and velocity profiles p sub 0 (z) and u sub 0 (z), a piece-wise constant profile of Brunt-Vaisala frequency, N(z), and a constant shear in the middle layer. The dispersion equation, derived from the Taylor-Goldstein equation with free surface and rigid bottom boundaries, is solved for the complex wave frequency omega as function of the horizontal wave number k by numerical computation. Dissert. Abstr.

N78-26707 California Univ., San Diego.
GLOBAL NUMERICAL MODELS OF THE OPEN OCEAN TIDES M2, S2, K1 ON AN ELASTIC EARTH Ph.D. Thesis
Michael Edward Parke 1978 164 p
Avail: Univ. Microfilms Order No. 7808094

The iterative procedures of Hendershott for solving Laplace's tidal equations with inclusion of ocean self-attraction and of solid earth ocean tides loading was implemented and found divergent for M2 and S2 tides and convergent for the K1 tide. In either case, the iterates were then successfully used as basis functions in least squares fits to the solution of LTE. The tidal model was then soluble but does not correctly model ocean tidal resonances. Near resonant solutions were therefore not realistic. To obtain realistic representation of ocean tides for geophysical applications, the iterates were used as basis functions in a least squares fit to island tidal observations. Numerical values of these fields are presented to facilitate wide geophysical application. Resulting estimates of ocean tidal energy loss were somewhat closer to Miller's oceanic estimates than previous theoretical estimates. Dissert. Abstr.

N78-26708 Louisiana State Univ. and A&M Coll., Baton Rouge.
SHALLOW-WATER WAVES AND FLUID-MUD DYNAMICS, COAST OF SURINAM, SOUTH AMERICA Ph.D. Thesis
John Thomas Wells 1977 113 p
Avail: Univ. Microfilms Order No. 7807566

Time series measurements of shallow water waves and fluid mud density variations, taken simultaneously with tide elevation and suspended sediment data, indicate that wave/fluid mud interactions in the nearshore may be largely responsible for the accumulation of fine grained sediment on the open, unprotected coast of northeastern South America. Results of field experiments conducted along the central Surinam coast show that accumulations of fluid mud, which can be found up to 1.5 m thick on western flanks of migrating shore-attached mudbanks, affect incoming swell by changing their form from sinusoidal to solitary-like and by preventing wave breaking except for occasional spilling. As long period swell (T = 12-16 sec) propagates over shallow banks of fluid mud, the wave height to water depth ratio remains nearly constant at 0.23. Dissert. Abstr.

N78-26709 Princeton Univ., N. J.
NUMERICAL MODELS OF THE OCEANIC HEAT TRANSPORT Ph.D. Thesis
Paul S. Schopf 1978 258 p
Avail: Univ. Microfilms Order No. 7807496

A dynamic diagnostic technique for determining the global oceanic heat transport was examined. Global temperature, salinity, and density data were used in conjunction with the equations of motion to determine the velocity field, from which advective heat transports were calculated. While the method is shown to have some inherent weaknesses, it was found that: (1) The Ekman effect can be important in the global oceanic heat transport. (2) Horizontal gyres do not appear to play a large role in the heat transport-the largest component of the transport being carried by the meridional overturning. (3) The total heat transport values determined by this model are far lower than those determined by Sellers (1965) or Oort and Vonder Haar (1976), except in the tropics. A linear model is used to study the cross-equatorial seasonal heat flux. Zonally uniform zonal winds are blown over a rectangular ocean with specified mean stratification. Dissert. Abstr.

N78-26710 California Univ., San Diego.
CONTINENTAL AND OCEANIC ISOSTASY Ph.D. Thesis
Marcia Kemper McNutt 1978 206 p
Avail: Univ. Microfilms Order No. 78-08092

Data from several continental and oceanic environments are analyzed in order to determine by what method the earth supports the excess weight of surface features. By selecting topographic loading examples that differ in the age of the features and the type of crust that is loaded, it is possible to investigate how isostatic compensation depends on the properties of the lithosphere and how it evolves with time. A viscoelastic plate compensation model explains the oceanic and continental observations. Dissert. Abstr.

N78-26711# National Science Foundation, Washington, D. C. Office for the International Decade of Ocean Exploration.
COASTAL UPWELLING ECOSYSTEMS ANALYSIS AND UPWELLING BIOME. DATA REPORT 37. R/V T. G. THOMPSON CRUISE 78. PART 2. MESCAL 2: PRODUCTIVITY, NEKTON BIOMASS, CURRENT METER AND DROGUE OBSERVATIONS, 24 MARCH - 6 MAY 1973. OUTFALL 2: HYDROGRAPHY AND PRODUCTIVITY, 7-14 MAY 1973
Terry E. Whitledge and H. Lee Conway Nov. 1977 149 p refs
(PB-278431/2; NSF/IDOE-78-15) Avail: NTIS HC A07/MF A01 CSCL 08A

The area of study for MESCAL 2 was in coastal waters in the vicinity of Punta San Hipolito, Baja California approximately 130 km south of Punta Eugenia and 650 km south of San Diego. Sampling occurred from 24 March to 6 May 1973 with most stations located in a 40 km by 120 km coastal area. This cruise was designed to reoccupy the upwelling region that was

investigated on R/V THOMAS G. THOMPSON cruise 67 (Mescal 1) in the spring of 1972. The second portion of R/V T.G. THOMPSON cruise 78 (OUTFALL 2) was devoted to the Southern California Bight near the Whites Point sewage outfall. The basic sampling plan was similar to OUTFALL 1 the previous year but with more emphasis on the horizontal distribution of the sewage plume and the distribution of chlorinated hydrocarbons. GRA

N78-26712# Nuclear Regulatory Commission, Washington, D. C. Core Performance Branch.
FISSION GAS RELEASE FROM FUEL AT HIGH BURNUP
R. O. Meyer, C. E. Beyer, and J. C. Voglewede Mar. 1978 65 p refs
(PB-278824/8; NUREG-0418) Avail: NTIS HC A04/MF A01 CSCL 08C

A safety analysis is performed for reactor license applications. Licensing actions are described that were taken to correct deficient gas release models used in safety analyses. A correction function, is presented. Related information, which includes some previously unpublished data, is also summarized. GRA

N78-26713# National Marine Fisheries Service, Seattle, Wash.
SURFACE CURRENTS AS DETERMINED BY DRIFT CARD RELEASES OVER THE CONTINENTAL SHELF OFF CENTRAL AND SOUTHERN CALIFORNIA
James L. Squire, Jr. Dec. 1977 21 p refs
(PB-278126/8; NOAA-TR-NMFS-SSRF-718; NOAA-78022203) Avail: NTIS HC A02/MF A01 CSCL 08C

Additional information was developed on the drift patterns to which surface planktonic forms are subjected over the continental shelf of the west coast of the United States. The general direction of surface drift was determined and is compared with wind velocity during the survey period to expose any general relationship between wind direction and inshore surface currents. The central area from Point Arena to Point Sur, Calif., and the southern area from Point Arguello, Calif., to Punta Salsipuedes, Baja California, Mexico is covered. Increased interest in coastal surface currents as they may pertain to the drift of surface pollutants, such as petroleum, prompted the documentation of this drift study. GRA

N78-26714# Florida State Univ., Tallahassee. Dept. of Meteorology.
COASTAL UPWELLING ECOSYSTEMS ANALYSIS DATA REPORT 42: AIRCRAFT SEA SURFACE TEMPERATURE DATA, JOINT 2 1977
David W. Stuart Nov. 1977 44 p refs Prepared for NSF
(PB-278649/9; FSU-CUEA-MET-77-1; DR-42; IDOE-78-16) Avail: NTIS HC A03/MF A01 CSCL 08J

The details of the reduction and analysis schemes employed for the aircraft sea surface temperature data are presented. Maps and profiles of the sea surface temperature data obtained on thirty (30) separate flights over the Joint 2 region during a forty-eight day period are presented. Plans for further analysis and comparison of the data are included. GRA

51 LIFE SCIENCES (GENERAL)

Includes genetics.

N78-26715*# National Aeronautics and Space Administration. National Space Technology Labs., Bay Saint Louis, Miss.
COMPILED DATA ON THE VASCULAR AQUATIC PLANT PROGRAM, 1975 - 1977
B. C. Wolverton and R. McDonald [1977] 149 p refs
(NASA-TM-79511) Avail: NTIS HC A07/MF A01 CSCL 06C

The performance of a single cell, facultative sewage lagoon was significantly improved with the introduction of vascular aquatic plants. Water hyacinth (Eichhornia crassipes) was the dominant plant from April to November; duckweed (Lemna spp.) and (Spirodela spp.) flourished from December to March. This 2 ha lagoon received approximately 475 cu m/day of untreated sewage and has a variable COD sub 5 loading rate of 22-30 kg/ha/day. During the first 14 months of operation with aquatic plants, the average influent BOD sub 5 was reduced by 95% from 110 mg/l to an average of 5 mg/l in the effluent. The average influent suspended solids were reduced by 90% from 97 mg/l to 10 mg/l in the effluent. Significant reductions in nitrogen and phosphorus were effected. The monthly kjeldahl nitrogen for influent and effluent averaged 12.0 and 3.4 mg/l, respectively, a reduction of 72%. The total phosphorus was reduced on an average of 56% from 3.7 mg/l influent to 1.6 mg/l effluent. Author

N78-26716*# National Aeronautics and Space Administration, Washington, D. C.
CONDITIONED REFLEX ACTIVITY OF RATS AT LATER PERIODS AFTER THE END OF FLIGHT ABOARD THE KOSMOS-605 BIOSATELLITE
N. N. Livshits, Ye. S. Meyzerov, Z. I. Apanasenko, and M. A. Kuznetsova Jul. 1978 13 p refs Transl. into ENGLISH from Zh. Vyssh. Nerv. Deyateln. im. I. P. Paulova (USSR), v. 28, no. 1, 1978 p 107-114 Transl. by Scientific Translation Service, Santa Barbara, Calif.
(Contract NASw-2791)
(NASA-TM-75523) Avail: NTIS HC A02/MF A01 CSCL 06S

The aftereffects of spaceflight on the higher nervous activity of rats were studied. A five lane maze with a feeding terminal was used to check such factors as transfer of experience, the habit and speed of reaching the goal in the maze, long term memory, and the dynamics of errors. During the 3rd-7th postflight week, functional disturbances in the rat HNA were manifested in the deterioration of the capacity for the transfer of experience and for locating the feeding compartment in the maze, thus indicating a general decrease of work capacity. The increased number of errors and failures pointed to exhaustion of higher nervous processes and to the weakened functional activity of the brain. G. G.

N78-26717*# National Aeronautics and Space Administration, Washington, D. C.
STRUCTURAL AND FUNCTIONAL ORGANIZATION OF THE VESTIBULAR APPARATUS IN RATS SUBJECTED TO WEIGHTLESSNESS FOR 19.5 DAYS ABOARD THE KOSMOS-782 SATELLITE
Ya. A. Vinnikov, O. G. Gazenko, L. K. Titova, A. A. Bronshteyn, V. I. Govardovskiy, R. A. Pevzner, G. G. Gribakin, M. Z. Aronova, T. A. Kharkeyevich, and T. P. Tsirulis Jul. 1978 11 p refs Transl. into ENGLISH from Arkh. Anat., Gistol. Embriol. (USSR), no. 1, 1978 p 27-28 Transl. by Scientific Translation Service, Santa Barbara, Calif.
(Contract NASw-2791)
(NASA-TM-75529) Avail: NTIS HC A02/MF A01 CSCL 06S

The vestibular apparatus was investigated in rats subjected to weightlessness for 19.5 days. The vestibular apparatus was removed and its sections were fixed in a glutaraldehyde solution for investigation by light and electron microscopes. Structural and functional charges were noted in the otolith portions of the ear, with the otolith particles clinging to the utricular receptor surface and with the peripheral arrangement of the nucleolus in the nuclei of the receptor cells. It is possible that increased edema of the vestibular tissue resulted in the destruction of some receptor cells and in changes in the form and structure of the otolith. In the horizontal crista, the capula was separated. G.G.

N78-26718# Rochester Univ., N. Y. School of Medicine and Dentistry.
BIOLOGICAL EFFECTS OF IONIZING RADIATION AT THE MOLECULAR, CELLULAR, AND ORGANISMAL LEVELS
Triannual Progress Report, 15 Jul. 1974 - 14 Oct. 1977
Christopher S. Lange 1977 16 p refs
(Contract EY-76-S-02-3501)
(TID-28055) Avail: NTIS HC A02/MF A01

Progress is reported on the following studies: organization and repair of DNA; size measurement of DNA by means of the ultracentrifuge; effects of hydroxyurea, cycloheximide, and methylmercury on cell cycle progression; absence of an effect of photoreactivation on sublethal damage repair in a photoreactivating Wallaby cell line; and the control of differentiation and tissue polarity in planarians. ERA

N78-26719# Stanford Linear Accelerator Center, Calif.
BIOMAGNETISM: A REVIEW

S. J. StLorant Jul. 1977 9 p refs Presented at 6th Intern. Conf. on Magnet Technol., Bratislava, Czechoslovakia, 29 Aug. 1977
(Contract EY-76-S-03-0326)
(SLAC-PUB-1984; Conf-770842-18) Avail: NTIS HC A02/MF A01

Biological effects of static and low frequency magnetic fields are reviewed, and the potential hazards associated with human exposure are discussed. It is concluded that the magnetic effects are fully reversible once the organism is permitted to return to its original environment. ERA

52 AEROSPACE MEDICINE

Includes physiological factors, biological effects of radiation; and weightlessness.

N78-26720 New York Univ., N. Y.
THE INFLUENCE OF TRACE METALS IN DISPERSE AEROSOLS ON THE HUMAN BODY BURDEN OF TRACE METALS Ph.D. Thesis
David Maier Bernstein 1977 329 p
Avail: Univ. Microfilms Order No. 7808506

A direct relationship was shown between the concentrations of trace metals in urban and other disperse aerosols and the concentrations of trace metals in human respiratory tissues. To obtain these results, a size selective particle sampler was developed for continuous sampling of the urban aerosol over periods ranging from hours to weeks. The system used a parallel array of four two stage samplers with cyclone first stage collectors. Undersize particles which passed through the cyclones were captured on glass fiber filters. Mass balances of the suspended particulates and trace elements collected on the cyclones and filters were obtained. Typical mass size distributions for summer and winter aerosols in New York City were determined. Dissert. Abstr.

N78-26721 Kansas State Univ., Manhattan.
COMPARISON OF AUDITORY CRITICAL BANDS MEASURED BY LOUDNESS SUMMATION AND ACOUSTIC REFLEXES Ph.D. Thesis
Galen Walter Berry 1977 63 p
Avail: Univ. Microfilms Order No. 7809332

The purpose was to examine the hypothesis that the critical band demonstrated at the threshold of the acoustic reflex is determined by loudness. The experiment examined the critical bandwidth in four normal hearing listeners, using two different psychophysical methods. Loudness balances and acoustic reflex measures were made to a two tone stimulus when the components comprising the complex were adjusted to an equal intensity level or an equal reflex level. Measurements following these adjustments facilitated the comparison of two tone loudness summation with two tone acoustic reflex threshold, as a function of sound pressure level. Measurements were made for various bandwidth spacings of the two tone complex ranging from 100 Hz to 3434 Hz. Dissert. Abstr.

N78-26722 New York Univ., N. Y.
EFFECTS OF STIMULUS REPETITION RATE AND SENSATION LEVEL UPON THE EEG FOLLOWING RESPONSE OF AWAKE HUMAN SUBJECTS Ph.D. Thesis
Manuel M. Cohen 1977 201 p
Avail: Univ. Microfilms Order No. 78-08456

The effects of stimulus repetition rate (RR) and sensation level (SL) upon the EEG Following Response (FR) evoked by monotic periodic clicks in 20 normal hearing awake adult human subjects were studied. Discussion of the effects of RR centered around the model of temporal overlapping of middle AER components to rapidly repeated click stimuli. The sinusoidal appearance of the FR and its waveform consistency across SLs were discussed in terms of a visual template approach to scoring AER records for the determination of auditory threshold. Differences between mean FR period and predicted period were interpreted in terms of middle AER waveform irregularities and their contribution to Following Response waveforms. It was suggested that deviations of mean FR period about the predicted period, for any particular RR, be converted to deviations of frequency of the FR waveforms. Dissert. Abstr.

N78-26723 Kansas Univ., Lawrence.
COMPARISONS AMONG AUDITORY REACTION TIME, LOUDNESS AND CERTAIN CHARACTERISTICS OF THE ACOUSTIC REFLEX Ph.D. Thesis
Lynne Marshall 1977 48 p
Avail: Univ. Microfilms Order No. 7809363

Loudness, auditory reaction time, and certain characteristics of the acoustic reflex (peak amplitude, latency, rise time, and fall time) were measured in ten normal-hearing listeners. Auditory reaction time and the acoustic reflex were measured concurrently, and loudness judgments by the method of direct magnitude estimation were made at a later time. The stimuli were pure tones ranging from 250-4000 Hz in octave intervals and broadband noise at intensities ranging from 35-115 db SPL. Equal loudness contours were in good agreement with those obtained by previous researchers, and the equal magnitude curves for reaction time were in good agreement with the equal loudness contours. For equal sound pressures, low frequency stimuli resulted in larger acoustic reflex contractions, shorter reflex latency, and faster rise time than did high frequency stimuli. Dissert. Abstr.

N78-26724*# National Aeronautics and Space Administration, Washington, D. C.
PATHOPHYSIOLOGICAL ASPECTS OF THE PROBLEM OF PROLONGED HYPOKINESIA
Ye. A. Kovalenko Jun. 1978 32 p refs Transl. into ENGLISH from Patol. Fiziol. Eksp. Ter. (USSR), no. 3, May-Jun. 1975 p 11-24 Transl. by Kanner (Leo) Associates, Redwood City, Calif.
(Contract NASw-2790)
(NASA-TM-75112) Avail: NTIS HC A03/MF A01 CSCL 06S

The changes in man's acitivity due to modern life with automation and sedentary activities and man's exploration of space in a state of weightlessness have accentuated the importance of hypokinesia. The pathogenesis of hypokinesia is discussed. Experiments and results made on man and animals are included. G.G.

N78-26725*# National Aeronautics and Space Administration, Washington, D. C.
SOME CLINICAL ASPECTS OF PROLONGED CLINOSTATIC HYPOKINESIA
A. Ya. Tizul, Ye. I. Sokolov, Yu. S. Mdinaradze, and L. M. Filatova Jun. 1978 8 p refs Transl. into ENGLISH from Sov. Med. (USSR), Jul. 1972 p 147-148 Transl. by Kanner (Leo) Associates, Redwood City, Calif. Original document prepared by Ministry of Public Health of the USSR, Moscow
(Contract NASw-2790)
(NASA-TM-75114) Avail: NTIS HC A02/MF A01 CSCL 06S

Attendant problems which arise with prolonged confinement of patients to bed are discussed. These disorders are of a hyperkinesic nature, and the symptoms are treated with pharmacological substances. G.G.

N78-26726*# National Aeronautics and Space Administration, Washington, D. C.
CONTRACTILE FUNCTION OF THE MYOCARDIUM WITH PROLONGED HYPOKINESIA IN PATIENTS WITH SURGICAL TUBERCULOSIS
V. P. Zakutayeva and N. I. Matiks Jun. 1978 10 p Transl. into ENGLISH from Zdravookhr. Kirgizii (USSR), no. 5, Sep. - Oct. 1976 p 8-12 Transl. by Kanner (Leo) Associates, Redwood City, Calif. Original document prepared by Kirgiz Scientific Research Inst. of Tuberculosis, USSR
(Contract NASw-2790)
(NASA-TM-75115) Avail: NTIS HC A02/MF A01 CSCL 06S

The changes in the myocardial contractile function with hypokinesia in surgical tuberculosis patients are discussed. The phase nature of the changes is noted, specifically the changes in the various systoles, diastole, and other parts of the cardiac cycle. The data compare these changes during confinement in bed with no motor activity to and with a return to motor activity after leaving the in-bed regimen. Author

N78-26727*# National Aeronautics and Space Administration, Washington, D. C.
SOME FEATURES OF THE BIOELECTRIC ACTIVITY OF THE MUSCLES WITH PROLONGED HYPOKINESIA
N. A. Belaya, R. Z. Amirov, Ye. A. Shaposhnikov, I. P. Lebedeva, and B. S. Sologub Jun. 1978 10 p refs Transl. into ENGLISH from Vop. Kurortol., Fizioter. Lech. Fiz. Kul't. (USSR), no. 3, May-Jun. 1975 p 238-241 Transl. by Kanner (Leo) Associates, Redwood City, Calif.
(Contract NASw-2790)
(NASA-TM-75116) Avail: NTIS HC A02/MF A01 CSCL 06S

The effects of prolonged hypokinesia, brought on by confinement to bed and the attendant lack of motor activity, on the bioelectric activity of muscles are studied. Electromyographic measurements of amplitude and frequency indicators of muscular bioelectric activity were analyzed. G.G.

N78-26728# Connecticut Univ., Farmington. School of Medicine.
TOXICOLOGY AND METABOLISM OF NICKEL COMPOUNDS Progress Report, 1 Dec. 1976 - 30 Nov. 1977
F. William Sunderman, Jr. 15 Aug. 1977 35 p refs
(Contract EY-76-S-02-3140)
(COO-3140-36) Avail: NTIS HC A03/MF A01

The toxicology and metabolism of Nickel compounds (NICL2, NI3S2, NIS, NI powder, and NI(CO)4) were investigated for their toxicological and metabolic effects in rats. ERA

N78-26729# Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
SOME OBSERVATIONS ON THE HUMAN VISUAL PERCEPTION SYSTEM AND THEIR RELEVANCE TO COMPUTER VISION RESEARCH
R. A. Jarvis Dec. 1977 81 p refs
(Grant NSF ENG-76-18567)
(PB-277938/7; TR-EE77-46) Avail: NTIS HC A05/MF A01 CSCL 06D

Properties of the human visual perception system considered to be of relevance in designing computer vision systems were observed. Sources of puzzlement and ambiguity of a number of well known optical illusions as well as decriptions and interpretations of psychological experiments which explore particular facets of the visual system organization were analyzed. GRA

N78-26730# National Technical Information Service, Springfield, Va.
TOXICITY OF VINYL CHLORIDE. A BIBLIOGRAPHY WITH ABSTRACTS Progress Report, 1969 - Apr. 1978
Pernell W. Crockett May 1978 86 p Supersedes NTIS/PS-77/0365; NTIS/PS-76/0197
(NTIS/PS-78/0442/6; NTIS/PS-77-0365; NTIS/PS-76/0197) Avail: NTIS HC $28.00/MF $28.00 CSCL 06T

Research is cited on the health hazards from exposure to vinyl chloride and vinyl chloride resins. Studies are included on the epidemiology of industrial and public exposures to the compound as well as its degradation and combustion products. (This updated bibliography contains 79 abstracts, 10 of which are new entries to the previous edition.) GRA

N78-26731# California Univ., Santa Barbara. Inst. of Environmental Stress.
THE EFFECT OF NITROGEN DIOXIDE ON LUNG FUNCTION IN NORMAL SUBJECTS Final Report
Steven M. Horvath and Lawrence J. Folinsbee Jan. 1978 82 p refs
(Contract EPA-68-02-1757)
(PB-277671/4; EPA-600/1-78-006) Avail: NTIS HC A05/MF A01 CSCL 06S

Cardiopulmonary and metabolic responses of three groups, each consisting of five adult males (age 19-29) were determined before, during, and after a 2 hour exposure to 0.062 plus or minus 0.12 ppm NO2 at 25 C and 45%RH. The three groups exercised during exposure at 40% of VO2 max for either 12, 30, or 60 min. for groups C, A, and B, respectively. During the exercise periods the ventilation was about 33 liters/min, a four-fold increase over the resting level. There were no physiologically significant cardiovascular, metabolic, or pulmonary function changes which could be attributed to exposure to this level of NO2 (0.62 ppm). There were no differences between the groups in their response despite the fact that groups A and B received more NO2 as a result of 28% and 84% greater ventilations respectively. GRA

N78-26732# Calspan Corp., Buffalo, N. Y.
INTERFACIAL BIOPHYSICS OF MATERIALS IN CONTACT WITH BLOOD Annual Report, 16 Dec. 1976 - 15 Dec. 1977
V. A. DePalma, R. E. Baier, and V. L. Gott 15 Dec. 1977 289 p refs Prepared in cooperation with Johns Hopkins Univ., Baltimore, School of Medicine
(Contract N01-HV-3-2953)
(PB-277928/8; CALSPAN-W06-EB-5307-M-5; NIH/NHLI-N01-HV-3-2953) Avail: NTIS HC A13/MF A01 CSCL 06L

The spontaneous adsorption of a protein film on solid surface is studied. The deciding factor for the degrees of adhesion is related to the nature of the conditioning protein film which first forms on the surface. Measures of the original electrical properties of solid substrates (e.g. surface potential difference, zeta potential, rest potential) are correlated to cell adhesion by determining the influence of such properties on the initial adsorptive events. Experimental characterization of substrate surfaces before and after exposure to fibrinogen dissolved in flowing buffered electrolytes, deals chiefly with the changed electrical properties of the surfaces. GRA

53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

N78-26733# Institute for Perception RVO-TNO, Soesterberg (Netherlands).
ACTH FRAGMENTS AND VERBAL LEARNING
W. A. Wagenaar 1977 7 p refs Partly sponsored by N. V. Organon
(IZF-1977-15; TDCK-69955) Avail: NTIS HC A02/MF A01

The results of three experiments previously reported separately are pooled. The total number of subjects amounts to 84, 42 in placebo and experimental groups. The total results reveal no effect of ACTH 4-10 on paired associate learning.
Author (ESA)

N78-26734# Institute for Perception RVO-TNO, Soesterberg (Netherlands).
SOME EFFECTS OF ORG. 2766 ON VARIOUS PERFORMANCE TASKS
A. W. K. Gaillard and C. A. Varey 1977 21 p refs Sponsored by N. V. Organon
(IZF-1977-18; TDCK-69957) Avail: NTIS HC A02/MF A01

The effects of the ACTH 4-9 analog Org. 2766 were investigated on a range of performance tasks consisting of skill learning (a self-paced reaction task), running memory span, verbal learning, and two nonverbal mental ability tests (closure flexibility and non verbal abstraction). Subjective ratings on feelings were taken, and heart rate was also measured. Only the 30 min reaction task produced significant drug effects. In this task performance tends to deteriorate as a function of time on task. This might be caused by boredom affecting the subject. The deterioration is counteracted by the ACTH 4-9 analog. These effects are very similar to those found in a previous study using ACTH 4-10 (Org. 0163). Both studies suggest that these drugs act on the motivational processes which are involved in continuous performance. Author (ESA)

N78-26735# Institute for Perception RVO-TNO, Soesterberg (Netherlands).
VOWEL SEGMENTS IN CONSONANTAL CONTEXTS: A SPECTRAL STUDY OF COARTICULATION
M. E. H. Schouten and L. C. W. Pols 1977 36 p refs Submitted for publication Sponsored by Neth. Organ. for the Advan. of Pure Res. (ZWO)
(IZF-1977-14; TDCK-69959) Avail: NTIS HC A03/MF A01

Five speakers read a list of 120 CVC words, containing all possible combinations of six initial consonants, four vowels, and five final consonants, and a story in which those words occurred as stressed syllables. Each speaker did this five times. For each speaker and for each of the two conditions (isolated words and text words) the average trajectory in the spectral vowel space of every CV and VC transition, and of the stationary part of the vowel was calculated. With a few exceptions, the stationary part of the vowel was found not to vary systematically with consonantal context, but the CV and, to a lesser extent, the VC transitions turned out to combine into a pattern that was quite consistent over speakers and conditions. Extrapolation of these transitions resulted in estimated consonant locus areas in the vowel space for the majority of consonants investigated.
Author (ESA)

N78-26736# Institute for Perception RVO-TNO, Soesterberg (Netherlands).
ACTH 4-10 AND ADAPTIVE LEARNING
W. A. Wagenaar, H. Timmers, and H. Frowein 1977 16 p refs Sponsored by N.V. Organon
(IZF-1977-13; TDCK-69960) Avail: NTIS HC A02/MF A01

In three successive experiments the effect of ACTH 4-10 on the performance of human subjects in a shift learning task was studied. In the first experiment some facilitating effects were observed, but this result was not replicated in the second experiment. In a third experiment, designed to provide a surplus of observations, it was finally shown that ACTH 4-10 had no effect on this kind of adaptive learning. The study concludes with a short discussion of sample sizes in drug experiments.
Author (ESA)

N78-26737# National Aerospace Lab., Amsterdam (Netherlands). Flight Div.
HUMAN MONITORING AND CONTROL BEHAVIOR MODELS AND EXPERIMENTS
P. H. Wewerinke 22 Oct. 1976 64 p refs
(NLR-TR-77010-U) Avail: NTIS HC A04/MF A01

The object of the study was to describe human monitoring behavior and to determine how it is affected by performing other, interfering (control) tasks. A model for automatic multivariable monitoring was tested against experimental data. Apart from monitoring, simultaneously monitoring and manual flight director control was studied to determine the interference between (interacting) subtasks. Combined monitoring and auditory tracking was also included. The results demonstrate that the multivariable monitor model adequately describes human monitor behavior in the tasks. A multivariable workload model was developed where computer workload proved to agree excellently with subjective ratings.
Author (ESA)

N78-26738# Loyola Univ., Chicago, Ill. Fire and Human Behavior Research Center.
A MODEL OF HUMAN BEHAVIOR IN A FIRE EMERGENCY Final Report
Leonard Bickman, Perry Edelman, and Michael A. McDaniel Dec. 1977 33 p refs Sponsored in part by HEW
(Contract NBS-6-9015)
(PB-277773/8; NBS-GCR-78-120) Avail: NTIS HC A03/MF A01 CSCL 05J

A conceptual model which describes some of the significant factors thought to influence human behavior in a fire emergency is reported. The model attempts to integrate previous research on fire and human behavior with relevant findings from the field of social psychology. The model involves three stages: (1) detection of cues; (2) definition of the situation; and (3) coping behavior. These stages describe the logical flow of behavior during a fire. Six categories are presented which are hypothesized to affect behavior at each stage in the model: (1) physiological/physical; (2) intrapersonal; (3) education/preparation; (4) social; (5) fire characteristics; and (6) physical environment. The potential value of the model in explaining behavior in actual fires and in formulating future research is demonstrated with specific examples.
GRA

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

N78-26739 Stanford Univ., Calif.
DEVELOPMENT OF PREDICTION MODELS FOR EFFORT LEVELS IN MANUAL JOBS Ph.D. Thesis
Temilola Kehinde 1978 143 p
Avail: Univ. Microfilms Order No. 7808804

Experiments were designed to investigate possible relationships between effort input and the frequency distribution of cycle times produced by subjects engaged in different types of manual industrial jobs. The subjects used were industrial workers from an electronics plant in San Carlos, California. Five different jobs were studied and the workers used as subjects could be classified as typical industrial workers. Each subject was suitably motivated to work for specified periods of time at four different predefined effort or motivational levels--slow, comfortable, incentive, and very fast (maximum). Series of successive cycle times were collected at each of the four levels. These cycle times were later used to make up the relevant frequency distributions. The jobs used for this study had different mean cycle times and different degrees of complexity. Dissert. Abstr.

N78-26740*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SPACE ECOSYNTHESIS: AN APPROACH TO THE DESIGN OF CLOSED ECOSYSTEMS FOR USE IN SPACE
R. D. MacElroy and M. M. Averner (California Univ. at Berkeley) Jun. 1978 41 p refs
(NASA-TM-78491) Avail: NTIS HC A03/MF A01 CSCL 06K

The use of closed ecological systems for the regeneration of wastes, air, and water is discussed. It is concluded that such systems, if they are to be used for the support of humans in space, will require extensive mechanical and physico-chemical support. The reason for this is that the buffering capacity available in small systems is inadequate, and that natural biological and physical regulatory mechanisms rapidly become inoperative. It is proposed that mathematical models of the dynamics of a closed ecological system may provide the best means of studying the initial problems of ecosystem closure. A conceptual and mathematical model of a closed ecosystem is described which treats the biological components as a farm, calculates the rates of flow of elements through the system by mass-balance techniques and control theory postulates, and can evaluate the requirements for mechanical buffering activities. It is suggested that study of the closure of ecosystems can significantly aid in the establishment of general principles of ecological systems.
Author

N78-26741*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
G-SEAT SYSTEM STEP INPUT AND SINUSOIDAL RESPONSE CHARACTERISTICS
Thomas W. Showalter and Robert J. Miller Jun. 1978 11 p
(NASA-TM-78478; A-7393) Avail: NTIS HC A02/MF A01 CSCL 05H

The step input and sinusoidal response characteristics of a pneumatically driven computer controlled G set are examined in this study. The response data show that this system can be modeled as a first order system with an 0.08 sec time lag and a 0.53 sec time constant.
Author

N78-26742# Royal Aircraft Establishment, Farnborough (England).
HUMAN ENGINEERING EVALUATION OF A MAN-MACHINE SYSTEM FOR SYSTEM OPTIMIZATION-ILLUSTRATED BY A COCKPIT EVALUATION
H. Denkscherz and R. M. Taylor, ed. Dec. 1977 38 p refs Transl. into ENGLISH of Rept. MBB-UFE-1351 Messerschmitt-Boelkow-Blohm, West-Germany, 9 Sep. 1977 37 p
(RAE-Lib-Trans-1952; BR62774; MBB-UFE-1351) Avail: NTIS HC A03/MF A01

Operator performance, hardware, software, and operating procedures were evaluated. The evaluation situation was

represented by a cockpit simulator. Data were acquired by observing and questioning the operators. The object of the evaluation is system optimization. J.A.M.

N78-26743# Cincinnati Univ., Ohio. Dept. of Engineering Science.
MULTI-RIGID-BODY SYSTEM DYNAMICS WITH APPLICATIONS TO HUMAN-BODY MODELS AND FINITE-SEGMENT CABLE MODELS Final Technical Report, 1 Jan. 1975 - 30 Sep. 1976
Ronald L. Houston and Chris E. Passerello 1 Aug. 1977 70 p refs
(Contract N00014-75-C-1164)
(AD-A052868; UC-ES-080177-4-ONR) Avail: NTIS HC A04/MF A01 CSCL 12/1

A computer-oriented method for obtaining dynamical equations of motion for large mechanical systems or chain systems is presented. A chain system is defined as an arbitrarily assembled set of rigid bodies such that adjoining bodies have at least one common point and such that closed loops are not formed. The equations of motion are developed through the use of Lagrange's form of d'Alembert's principle. The method is illustrated and applied with human-body models and finite-segment cable models. The human-body models are configured to simulate a crash-victim. Results with several applied deceleration profiles agree very well with available experimental data. The cable model is configured to simulate an off-shore oil rig or ship's crane with a partially submerged towing cable. Author (GRA)

N78-26744# Chemical Lab. RVO-TNO, Rijswikj (Netherlands).
DETERMINATION OF THE CONCENTRATION OF CADMIUM AEROSOL AND OF SOME OTHER CONTAMINANTS PRESENT IN THE ATMOSPHERE OF A SUBMARINE OF THE ROYAL DUTCH NAVY
F. Oeseburg Dec. 1976 29 p refs
(Contract A74/KM/033)
(CL-1976-23; TDCK-68819) Avail: NTIS HC A03/MF A01

Cadmium aerosol concentrations in the atmosphere, originating from operating sonar equipment on board a three-cylinder submarine of the Royal Dutch Navy, were measured to check the possible health risk to the different members of the crew. It turned out that these concentrations met the Dutch standard value. Additional measurements were carried out to get a more complete picture of the contaminants present in the atmosphere of the submarine. From these the conclusion was drawn that the concentrations of the number of metal aerosols other than cadmium also met the Dutch standard value. In all cases the concentration dust exceeded the norm. Author (ESA)

N78-26745# National Aerospace Lab., Amsterdam (Netherlands). Flight Div.
A THEORETICAL FRAMEWORK TO STUDY THE EFFECT OF COCKPIT INFORMATION
P. H. Wewerinke 3 Jan. 1978 7 p refs Presented at the AGARD ASMP-Specialists Meeting, Athens, 20-24 Sep. 1976 (NLR-MP-76014-U) Avail: NTIS HC A02/MF A01

A theoretical framework describing human operator's participation in manned vehicle systems is developed. The human operator is described in terms commensurate with those used for other system elements, because of the complex interaction between human functioning and his task environment (e.g., cockpit information). The result is an integrated model of the man-machine situation serving as a diagnostic tool and allowing the extrapolation to new situations. The theoretical framework deals with manned vehicle systems involving the human operator performing continuous control and/or decision making tasks. It is shown how the effect of cockpit information (e.g. type, quality and interference of displayed information, both visual and auditory) on human functioning and mission success can be operationalized and straightforwardly investigated. Author (ESA)

N78-26746# National Inst. for Occupational Safety and Health, Morgantown, W. Va. Testing and Certification Branch.
SILICA DUST TEST FOR RESPIRATORY PROTECTIVE DEVICES
Warren R. Myers Jul. 1977 40 p
(PB-278019/5; NIOSH/TC/R-009) Avail: NTIS HC A03/MF A01 CSCL 06Q

The silica dust test evaluates the performance of air-purifying respirators against dusts of materials having a TWA not less than 0.05 mg/cu m or 2 mppcf. This test also evaluates the resistance performance of pesticide respirators and filters to be used against materials having a TWA less than .05 mg/cu m or 2 mppcf. The dust test procedure is designed to determine whether a respirator meets test performance requirements for maximum allowable penetration and for maximum allowable breathing resistances. GRA

N78-26055# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. Fuer Flugfuehrung.
FLIGHT PERFORMANCE AND PILOT WORKLOAD IN HELICOPTER FLIGHT UNDER SIMULATED IMC EMPLOYING A FORWARD LOOKING SENSOR
R. Beyer *In* AGARD Guidance and Control Design Considerations for Low-Altitude and Terminal-Area Flight Apr. 1978 9 p refs (For availability see N78-26049 17-01)
Avail: NTIS HC A14/MF A01

N78-26056# Forschungsinstitut fuer Anthropotechnik, Meckenheim (West Germany).
HUMAN ENGINEERING EVALUATION OF A COCKPIT DISPLAY/INPUT DEVICE USING A TOUCH SENSITIVE SCREEN
Klaus-P Gaertner *In* AGARD Guidance and Control Design Considerations for Low-Altitude and Terminal-Area Flight Apr. 1978 13 p refs (For availability see N78-26049 17-01)
Avail: NTIS HC A14/MF A01

55 PLANETARY BIOLOGY

Includes exobiology and extraterrestrial life.

No abstracts in this category.

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

No abstracts in this category.

60 COMPUTER OPERATIONS AND HARDWARE

Includes computer graphics and data processing.
For components see *33 Electronics and Electrical Engineering.*

N78-26747 Kansas Univ., Lawrence.
TOWARDS THE DESIGN AND IMPLEMENTATION OF A UNIFIED DATA BASE MANAGEMENT SYSTEM Ph.D. Thesis
James Robert Driscoll 1977 157 p
Avail: Univ. Microfilms Order No. 7809346

The problem of developing a data base management system (DBMS) which can support different user views is addressed. The need to support at least the network, hierarchical and relational models and languages is met by introducing model definition primitives (MDP), model navigation primitives (MNP) and sufficient system structure to enable specification of user data definition language (DDL) and data manipulation language (DML) to define the various views. The MDP and MNP are defined with respect

to a precise concept of a link based on the connection properties of data value occurrences. A precise definition of the link concept, which has not been carefully formulated in the literature, is critical to the development of a unified DBMS. Specific hierarchical, network and relational examples are included to demonstrate that their DDL and DML can indeed be defined in terms of the MDP and MNP. Dissert. Abstr.

N78-26748# Pennsylvania Univ., Philadelphia. Dept. of Computer and Information Sciences.
NOPAL PROCESSOR: INTRA-TEST SEQUENCING Final Report, 30 Jun. 1975 - 31 Aug. 1977
Ronald Wayne Berman Jan. 1978 110 p refs
(Contract DAAA25-75-C-0650; DA Proj. 1G6-63622-AJ-29) (AD-A053315; ECOM-75-0650-F) Avail: NTIS HC A06/MF A01 CSCL 14/2

This report describes the algorithms, methods, and programs that represent the intra test sequencing phase of the NOPAL processor. The overall objective of the NOPAL system is to generate a program for computer controlled automatic test equipment for testing an electronic unit under test. The input to the system is a nonprocedural description of the desired test expressed in the NOPAL language. The present report describes how such a specification can be analyzed and how a flowchart can be generated for performing the test. A subsequent phase of NOPAL generates a program based on the flowchart. The report can be read independently of the NOPAL processor. Readers interested only in the automatic sequencing of operations in a program can omit Chapters 1 and 2, which describe the NOPAL language and processor. Readers interested in greater detail on the NOPAL processor can obtain further information in the references listed in the bibliography. Author (GRA)

N78-26749# TRW Defense and Space Systems Group, Redondo Beach, Calif.
TED IC TECHNIQUE EVALUATION AND A/D CELL DEVELOPMENT Final Technical Report, May 1976 - Jul. 1977
Dale C. Claxton, Ted D. Leisher, and Tom G. Mills Feb. 1978 49 p refs
(Contract N00014-76-C-0743)
(AD-A053320) Avail: NTIS HC A03/MF A01 CSCL 09/2

The objectives of this program were to further advance the fabrication technology of small scale GaAs integrated circuits and to demonstrate the technology by fabricating and evaluating a 5 gigasample per second (Gs/sec) analog-to-digital converter bit cell. These objectives were met. In the TED/FET bit cell design the sampling and amplitude quantization are performed by a dual-gate TED under the control of a single-gate TED, the output bit is provided by the dual-gate TED, and the feed forward signal is generated by a FET differential pair. A total of only five active devices, including a FET current source, are required to perform these functions. The sampling rate actually achieved by the A/D cells was in excess of 8 Gs/sec, well beyond the 5 Gs/sec design goal. Additionally, the sampling rate is variable from 0 to 8 Gs/sec, unlike conventional A/D designs which generally operate only at one fixed sample rate, and well below 1 Gs/sec. The chief shortcoming of the A/D bit cells fabricated and tested under this program was inaccuracy of the feed forward gain, which was generally low. This is directly attributable to low FET transconductance, but pointed up the need for a means of adjusting cell gain. Some changes could also be made in the cell layout to improve port-to-port isolation, but this was not a critical item. Author (GRA)

N78-26750# Naval Surface Weapons Center, Dahlgren, Va.
A COMPARISON OF APPROACHES TO PROVIDE A DEBUGGING SYSTEM FOR THE AN/UYK-20 Final Report
Ronald L. Hartung Nov. 1977 30 p refs
(AD-A052876; NSWC/DL-TR-3729) Avail: NTIS HC A03/MF A01 CSCL 09/2

This study was conducted to establish feasible approaches to debugging programs for the AN/UYK-20, the Navy's standard minicomputer. Five approaches are identified and compared: internal, external, hybrid, software, and virtual machine. The results of this study can be generalized to cover the problems of program debugging for all digital computers. Author (GRA)

N78-26751# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
BUS INTERFACE UNIT DESIGN FOR THE DISTRIBUTED PROCESSOR/MEMORY SYSTEM M.S. Thesis
Leslie T. Konno Dec. 1977 234 p refs
(AD-A053269; AFIT/GE/EE/77-24) Avail: NTIS HC A11/MF A01 CSCL 09/2

This report describes the design of the Bus Interface Unit for the Distributed Processor/Memory (DP/M) System. The DP/M System, which is being developed by the Air Force Avionics Laboratory, is a concept to integrate avionics on board an aircraft by utilizing a number of programmable processor/memory elements (PE's) in a distributed (decentralized) network. All the PE's in the system are interconnected by a pair of redundant global buses and PE's in an affinity group are additionally interconnected by a local bus. This effort involves the design of the Bus Interface Unit (BIU) of the PE. The BIU interfaces the parallel-data PE processor with the two redundant serial global buses and the serial local bus. The BIU has been designed as an interrupt driven microprogrammed processor. The design uses a bipolar bit-slice microprocessor, specifically the Am2900 Bipolar Microprocessor Family, for emulating the BIU functions. This report starts with a brief description of the DP/M System, followed by a detailed description of the BIU functions. Then the hard-ware, the microword format, and the microroutines are described. A discussion on the design effort is presented at the end, and recommendations are made for system improvement. Author (GRA)

N78-26752# University of Southern Calif., Marina del Rey. Information Sciences Inst.
PROTECTION ERRORS IN OPERATING SYSTEMS: A SELECTED ANNOTATED BIBLIOGRAPHY AND INDEX TO TERMINOLOGY
Jim Carlstedt Mar. 1978 48 p
(Contract DAHC15-72-C-0308; ARPA Order 2223)
(AD-A053016; ISI/SR-78-10) Avail: NTIS HC A03/MF A01 CSCL 09/2

This report represents the current state of a bibliography on the subject of protection in computer operating systems. 'Current state' means that the bibliography is incomplete; it is a byproduct of a research project in the field of protection, recently completed. The bibliography is being published in the belief that it may be useful as is, and that it might serve as the basis of a continuing effort to collect, annotate and index the more significant documents (reports, papers, articles, books, etc.) in the field. Ideally (especially in these days of computerized information bases and communication networks) workers in a research field will collaborate in developing and sharing their bibliographies--not only with simple annotations like this one but with more extensive comments and review. Perhaps this document can be a contribution in that direction and will stimulate owners of other 'working' bibliographies to publish theirs. As noted below, this bibliography is online and may be accessed via the ARPANET, (Defense Advanced Research Projects Agency network of interconnected scientific computers). GRA

N78-26753# California Univ., Livermore. Lawrence Livermore Lab.
MAG MCS-8: A BUS-ORIENTED MICROCOMPUTER
R. T. Bradley 14 Nov. 1977 14 p ref
(Contract W-7405-eng-48)
(UCID-17656) Avail: NTIS HC A02/MF A01

Design and implementation of a bus-oriented microprocessor which is compatible with the DEC doublewidth, extended length circuit card format are described. Details of construction, use, and interfacing are included. ERA

N78-26754# Sandia Labs., Albuquerque, N. Mex. Data Processing Div.
FLOATING-POINT ARITHMETIC UNIT FOR PRO-LOG BASED CONTROL SYSTEMS
D. C. Macmillan Jan. 1978 23 p
(Contract EY-76-C-04-0789)
(SAND-77-8041) Avail: NTIS HC A02/MF A01

A floating-point unit was designed for use with control systems based on Pro-Log four-bit or eight-bit microprocessors. The unit consists of a single board which can be pin-connected into existing

control systems. It provides the capability for floating-point arithmetic computations, including operations with transcendental and exponential functions. ERA

N78-26755# Bendix Corp., Kansas City, Mo.
PROGRAMMABLE DATA ACQUISITION SYSTEM FOR MICROWAVE CALIBRATION
J. W. Cable Jan. 1978 32 p refs Revised
(Contract EY-76-C-04-0613)
(BDX-613-1722-Rev; MEP-74-78) Avail: NTIS HC A03/MF A01

A fully automated, programmable data acquisition system was developed to record by printout or on punched paper tape the data for microwave power calibration. The system programs, controls, and receives BCD, analog, and ASCII information from external instrumentation. Construction, requirements, and operation of the system are described, and wiring diagrams are included. ERA

N78-26756# Sandia Labs., Albuquerque, N. Mex. TM Development Div. 9421.
MEMORY CONTROLLED DATA PROCESSOR
Charles S. Johnson Dec. 1977 42 p
(Contract EY-76-C-04-0789)
(SAND-77-0858) Avail: NTIS HC A03/MF A01

The Memory Controlled Data Processor (MCDP) was designed to provide a high-speed multichannel processor and data formatter for the Adaptive Intrusion Data System. It can address up to 48 analog data channels, 48 bilevel alarm data channels, and numerous miscellaneous data channels such as weather and time. A digital comparator in the MCDP can make comparisons between the data being processed and threshold limits programed for any channel. The MCDP is software oriented and has its instructions stored in a 4K core memory. ERA

N78-26757# California Univ., Livermore. Lawrence Livermore Lab.
ACT: AN 8080 MACRO PROCESSOR
Alexander Cecil 6 Feb. 1978 14 p refs
(Contract W-7405-eng-48)
(UCID-17722) Avail: NTIS HC A02/MF A01

A macro text interpreter is reported that runs under the CP/M floppy disk operating system on a microcomputer which can execute the Intel 8080 instruction set. ACT uses the same scanning algorithm as TRAC, but ACT has a modified set of primitive functions. ACT was used to program smart terminal operations and to process diskette files. ERA

N78-26758# Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
COMPUTER IMAGE SEGMENTATION: FIRST PARTITIONS USING SHARED NEAR NEIGHBOR CLUSTERING
R. A. Jarvis Dec. 1977 46 p refs
(Grant NSF ENG-76-18567)
(PB-277929/6; TR-EE77-43) Avail: NTIS HC A03/MF A01 CSCL 09B

A first partition region based image segmentation stragegy is elaborated which applies a shared near neighbor clustering procedure to feature sets extracted from color imagery. A hypothesis concerning the nature of low level visual cohesion in the domain of intensity and color imagery data was posed, and it suggested that the selected clustering rule, applied in parallel to overlapping extended spatial neighborhoods, reflects this hypothesis appropriately. Experimental results are presented to illustrate the effectiveness of the method and to allow subjective evaluation. GRA

N78-26759 National Technical Information Service, Springfield, Va.
DATA BASE MANAGEMENT. CITATIONS FROM THE NTIS DATA BASE Progress Report, 1964 - Mar. 1978
George W. Reimherr Apr. 1978 213 p Supersedes NTIS/PS-77/0314; NTIS/PS-76/026S
(NTIS/PS-78/0328/1; NTIS/PS-77/0314; NTIS/PS-76/0365) Avail: NTIS HC $28.00/MF $28.00 CSCL 09B

The advent of on-line systems, and the increasing problems of file organization file maintenance, and file structures of data bases, has required the study and development of data base management systems. This bibliography of Federally-funded research cites the development of software packages and implementation of data base management systems into various information systems. Also cited are guidelines for use in optimizing and modeling data bases. (This updated bibliography contains 208 abstracts, 55 of which are new entries to the previous edition.) GRA

N78-26760 National Technical Information Service, Springfield, Va.
DATA BASE MANAGEMENT. CITATIONS FROM THE ENGINEERING INDEX DATA BASE Progress Report, 1970 - Mar. 1978
George W. Reimherr Apr. 1978 152 p Supersedes NTIS/PS-77/0315; NTIS/PS-76/0266
(NTIS/PS-78/0329/9; NTIS/PS-77-0315; NTIS/PS-77/0315; NTIS/PS-76/0266) Avail: NTIS HC $28.00/MF $28.00 CSCL 09B

The advent of on-line systems, and the increasing problems of file organization, file maintenance, and file structures of data bases, have resulted in the study and development of data base management systems. The bibliography of worldwide literature cites research on the development of software packages and the implementation of data base management systems into various information systems. Also cited are guidelines for use in optimizing and modelling the data bases. GRA

61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, and algorithms.

N78-26761 British Broadcasting Corp., Kingswood (England). Dept. of Research.
THE USE OF A PROGRAMMED COMPUTER TO PERFORM REAL-TIME COMPANDING OF HIGH-QUALITY SOUND SIGNALS
G. W. McNally Apr. 1978 11 p refs
(BBC-RD-1978/14) Avail: BBC Kingswood Warren, Tadworth, Surrey, England

A small computer was used to process digital sound signals in real time under the control of a stored program. This has permitted the execution of the processing involved in six companding systems, which are currently under examination for possible use in national and international transmission networks. The subjective performances of the compandors were compared and the investigation of the effect of changing parameters was simplified. Author

N78-26762 Stanford Univ., Calif.
AUTOMATIC CONSTRUCTION OF ALGORITHMS AND DATA STRUCTURES USING A KNOWLEDGE BASE OF PROGRAMMING RULES Ph.D. Thesis
David Robbins Barstow 1978 285 p
Avail: Univ. Microfilms Order No. 78-08761

An explication is given of certain kinds of programming knowledge to a sufficient level of detail that it can be used effectively by a machine in the task of constructing concrete implementations of abstract algorithms in the domain of symbolic programming. Knowledge about several aspects of symbolic programming is expressed as a collection of four hundred refinement rules. The rules deal primarily with collections and mappings and ways of manipulating such structures, including several enumeration, sorting and searching techniques. The principle representation techniques covered include the representation of sets as linked lists and arrays (both ordered or unordered), and the representation of mappings as tables, sets of pairs, property list markings, and inverted mappings (indexed by range element). In addition to these general constructs, many low-level programming details are covered (such as the use of variables to store values). Dissert. Abstr.

N78-26763# Texas Univ., Austin. Inst. for Computing Science and Computer Applications.
HAL/S/V: A VERIFIABLE VERSION OF HAL/S

James C. Browne, Donald I. Good, Anand R. Tripathi, and William D. Young 30 Jun. 1978 58 p
Avail: NTIS HC A04/MF A01

The preliminary verifiable subset of the HAL/S language is defined. The overall properties of HAL/S compilations are reviewed on an abstract level and then related to the need for good programming practice. Topics discussed include: the structure and symbology of HAL/S; a HAL/S compilation: the program block; data declaration; replace statements; data referencing and subscripting; expressions; assignments; conditional statements and branches; statement groups; procedures and functions, input/output statements; and real time programming. A.R.H.

N78-26764# Federal COBOL Compiler Testing Service, Washington, D. C.
COBOL COMPILER VALIDATION SUMMARY REPORT
13 Apr. 1978 88 p
(AD-A053318; FCCTS/CCVS74-VRS259) Avail: NTIS HC A05/MF A01 CSCL 09/2

This Validation Summary Report (VSR) for the IBM 370 COBOL Compiler Version 2 Mol 1 MVS Version 3.7 VS2/SU8 provides a consolidated summary of the results obtained from the validation of the subject compiler against the 1974 COBOL Standard (X3.23-1974/FIPS PUB 21-1). The compiler was validated at the High level of FIPS PUB 21-1. The VSR is made up of several sections showing the discrepancies found. These include an overview of the validation which lists all categories of discrepancies by level/module within X3.23-19, a section relating the categories of discrepancies to each of the Federal levels of the language; and a detailed listing of discrepancies together with the tests which were failed.
Author (GRA)

N78-26765# System Development Corp., Santa Monica, Calif.
SOFTWARE ACQUISITION MANAGEMENT GUIDEBOOK: VALIDATION AND CERTIFICATION
Allan M. Skrukrud and Norman E. Willmorth Hansom AFB, Mass. ESD Aug. 1977 51 p refs
(Contract F19628-76-C-0236)
(AD-A053039; SDC-TM-5772/003/02; ESD-TR-77-326) Avail: NTIS HC A04/MF A01 CSCL 09/2

This report is one of a series of Software Acquisition Management Guidebooks which provide information and guidance for ESD Program Office personnel who are charged with planning and managing the acquisition of command, control, and communications system software procured under Air Force 800 series regulations and related software acquisition management concepts. It provides a review of the validation and certification practices and procedures employed by industry and set forth in relevant Department of Defense and Air Force regulations, specifications, and standards. It: (1) defines the terms 'validation' and 'certification', and distinguishes them from the term 'verification' as applied to software; (2) describes the software-related plannings, system engineering, and testing activities carried out by the Program Office which lead to system validation and certification; (3) provides guidance in planning and executing those software-related activities necessary to successfully achieve system validation and certification; (4) references other guidebooks in this series which provide more detailed information on the specific software techniques and tools required in system validation and certification; (5) references the appropriate Department of Defense and Air Force regulations, specifications, and standards that establish the basis for system validation and certification.
Author (GRA)

N78-26766# Science Applications, Inc., McLean, Va.
DOCUMENTATION OF PDP 11/70 SOFTWARE FOR DETERMINING TRAVEL-TIME DIFFERENCES FROM CROSS COVARIANCES
L. S. Blumen 23 Dec. 1977 45 p refs
(Contract N00039-76-C-0326)
(AD-A052891; SAI-78-713-WA) Avail: NTIS HC A03/MF A01 CSCL 17/1

The Navelex 320 Surface Shipping problem is resolved by the development of a method of correlating signals received from two widely spaced hydrophones, in an effort to locate the source. An exposition of the theoretical approach to this problem has been documented previously. This report deals with the actual implementation of the solution, through the use of current computer technology. GRA

N78-26767# George Washington Univ., Washington, D. C. Inst. for Management Science and Engineering.
SENSITIVITY ANALYSIS IN NONLINEAR PROGRAMMING USING FACTORABLE SYMBOLIC INPUT
Anura DeSilva and Garth P. McCormick 8 Mar. 1978 24 p refs
(Contract N00014-75-C-0611)
(AD-A053241; Serial-T-365) Avail: NTIS HC A02/MF A01 CSCL 12/1

This paper develops the formulas and methodology to utilize the input to nonlinear programs in symbolic factorable form to perform first order sensitivity analysis on the solution vector of a general nonlinear program. Author (GRA)

N78-26768# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
A CATEGORIZATION AND EVALUATION OF FORMAL AND SEMI-FORMAL DEFINITION TECHNIQUES M.S. Thesis
Bruce Daniel Guilmain Mar. 1978 117 p refs
(AD-A052917; AFIT/GE/MA/78M-1) Avail: NTIS HC A06/MF A01 CSCL 09/2

Operational techniques for defining computer programming languages are examined; specifically, SEMANOL, the Vienna Definition Language (VDL), and BASIS/1-12. A survey of the operational methods is given, in which specific examples of SEMANOL, the VDL, and BASIS/1-12 are explained in detail. A cataloging criteria is established and evaluated. The cataloging criteria is then used to categorize and evaluate SEMANOL, the VDL, and BASIS/1-12. The SEMANOL technique was judged as the best technique followed by BASIS/1-12 and the VDL, in that order. Author (GRA)

N78-26769# Stanford Univ., Calif. Computer Science Dept.
ON PROGRAM SYNTHESIS KNOWLEDGE
David R. Barstow and Cordell Green Nov. 1977 66 p refs
(Contract MDA903-76-C-0206; ARPA Order 2494)
(AD-A053175; SU-STAN-CS-77-639; AIM-306) Avail: NTIS HC A04/MF A01 CSCL 09/2

This paper presents a body of program synthesis knowledge dealing with array operations, space reutilization, the divide and conquer paradigm, conversion from recursive paradigms to iterative paradigms, and ordered set enumerations. Such knowledge can be used for the synthesis of efficient and in-place sorts including quicksort, mergesort, sinking sort, and bubble sort, as well as other ordered set operations such as set union, element removal, and element addition. The knowledge is explicated to a level of detail such that it is possible to codify this knowledge as a set of program synthesis rules for use by a computer-based synthesis system. The use and content of this set of programming rules is illustrated herein by the methodical synthesis of bubble sort, sinking sort, quicksort, and mergesort. Author (GRA)

N78-26770# Stanford Univ., Calif. Dept. of Computer Science.
AUTOMATIC CONSTRUCTION OF ALGORITHMS AND DATA STRUCTURES USING A KNOWLEDGE BASE OF PROGRAMMING RULES
David R. Barstow Nov. 1977 222 p
(Contract MDA903-76-C-0206; ARPA Order 2494)
(AD-A053184; SU-STAN-CS-77-641; AIM-308) Avail: NTIS HC A10/MF A01 CSCL 09/2

Although large amounts of programming knowledge are available to human programmers in the form of books and articles, very little of this knowledge is available in a form suitable for use by a machine in performing programming tasks automatically. The principal goal of the research reported here is the explication of programming knowledge to a sufficient level of detail that it can be used effectively by a machine. The programming task considered in this experiment is that of constructing concrete implementations of abstract algorithms in the domain of symbolic programming. Knowledge about several aspects of symbolic programming has been expressed as a collection of four hundred refinement rules. The rules deal primarily with collections and mappings and ways of manipulating such structures, including

several enumeration, sorting and searching techniques. The principal representation techniques covered include the representation of sets as linked lists and arrays (both ordered and unordered), and the representation of mappings as tables, sets of pairs, property list markings, and inverted mappings (indexed by range element). In addition to these general constructs, many low-level programming details are covered (such as the use of variables to store values). GRA

N78-26771# TRW Defense and Space Systems Group, Redondo Beach, Calif.
FUNCTIONAL PROGRAMMING Final Technical Report, 9 Jun. - 15 Jul. 1977
J. R. Brown and E. C. Nelson Feb. 1978 109 p
(Contract F30602-76-C-0315)
(AD-A052997; RADC-TR-78-24) Avail: NTIS HC A06/MF A01 CSCL 09/2

This document is the final technical report and computer program documentation for the project entitled Functional Programming, Contract F30602-76-C-0315. It presents the results of a thirteen month study of a new methodology for software development. The new techniques, collectively called Functional Programming (FP), are described in the report as are the results of varied applications of the methods in both the rewriting of existing programs and the development of new programs. The purpose of the report is to: (1) describe the FP methodology in sufficient detail to permit an average programmer to understand and employ FP practices and succeed in developing computer programs embodying FP principles, (2) provide detailed documentation of the sample programs as necessary to illustrate the contrast between conventional programs and functional programs including functional descriptions, source listings and logic diagrams, and (3) present findings of the study of the potential benefits to be derived from using FP, especially with regard to improved testability, reliability, and maintainability of computer programs. Author (GRA)

N78-26772# Stanford Linear Accelerator Center, Calif.
SLED PROGRAM
Z. D. Farkas Apr. 1977 27 p
(Contract EY-76-S-03-0326)
(SLAC-TN-77-1) Avail: NTIS HC A03/MF A01

A FORTRAN program is described which, for a given cavity and timing, yields all fields as a (piecewise) function of time, and which for any mix of SLEDded and non-SLEDded klystrons of any given energy/klystron, yields the SLED operation parameters. The note explains the input and output parameters as they appear in the code output. ERA

N78-26773# Sandia Labs., Livermore, Calif.
RT11LIB: A LIBRARY OF SUBROUTINES FOR TRANSFERRING DATA BETWEEN A PDP-11 AND A CDC-6600
H. D. Jones Jan. 1978 14 p
(Contract EY-76-C-04-0789)
(SAND-77-8271) Avail: NTIS HC A02/MF A01

The RT11LIB is a library of subroutines available to CDC 6600 users for the purpose of transferring data or program listings between a PDP-11 and a CDC 6600. These subroutines, operating on a CDC 6600 under the NOS/BE or SCOPE 3.4 operating systems, read or write magnetic tapes that are compatible with the PDP-11's RT11 operating system. Data written on the tape by the PDP-11 can be read by these subroutines and then translated into CDC 6600 format for subsequent data analysis. The translation process provides for many data formats, including byte, integer, floating point, and character string formats. Alternatively, data from the CDC 6600 can be translated into PDP-11 format then written onto the tape for subsequent use on the PDP-11. ERA

N78-26774# Sandia Labs., Albuquerque, N. Mex.
SOFTWARE DEVELOPMENT OF A REAL TIME SIGNAL PROCESSING SYSTEM
N. A. Bourgeois, Jr. Dec. 1977 36 p refs Sponsored in part by Air Force
(Contract EY-76-C-04-0789)
(SAND-77-1684) Avail: NTIS HC A03/MF A01

A method of developing real-time signal processing assembly language code is described. The technique presented includes the use of fixed-point arithmetic. A sample program of a real-time nonrecursive adaptive filter followed by an averaging detector is also included. ERA

N78-26775# Sandia Labs., Albuquerque, N. Mex.
USER/PROGRAMMER GUIDE FOR UCMD 87: GENERATION OF WINDOWS
D. K. Robbins Jan. 1978 21 p refs
(Contract EY-76-C-04-0789)
(SAND-77-1609) Avail: NTIS HC A02/MF A01

A description is given of program UCMD 87 - an Applicon AGS/870 User Command for generating windows with input from the dimensions contained in Window 0. ERA

N78-26776# Sandia Labs., Albuquerque, N. Mex. Applied Mathematics Div.
MODIFICATIONS OF SUPORT, A LINEAR BOUNDARY VALUE PROBLEM SOLVER. PART 1: PRE-ASSIGNING ORTHONORMALIZATION POINTS, AUXILIARY INITIAL VALUE PROBLEM, DISK OR TAPE STORAGE
Bruce L. Darlow, Melvin R. Scott, and Herman A. Watts Aug. 1977 27 p refs
(Contract EY-76-C-04-0789)
(SAND-77-1328-Pt-1) Avail: NTIS HC A03/MF A01

Some new capabilities of the code SUPORT, which solves linear two-point boundary-value problems are discussed. One modification now allows the user to pre-assign a set of orthonormalization points. In this mode of operation, the code does not check when orthonormalization should take place, so care must be taken in selecting the points to produce a satisfactory solution. Some guidelines are offered in using this option. Another capability allows the user easily to solve a boundary-value problem which depends on the solution of a nonlinear initial-value problem. This solution is achieved by simultaneous integration of all equations. Another capability allows the user the option of utilizing disk or tape storage for intermediate computations, and thereby reduce the in-core storage requirements for a large problem. ERA

N78-26777# Sandia Labs., Albuquerque, N. Mex.
NOSPLOT: A COMPUTER PROGRAM FOR PLOTTING SCORS OUTPUT ON A TEKTRONIX TERMINAL
Nancy Ruiz 1 Nov. 1977 18 p refs
(Contract EY-76-C-04-0789)
(SAND-77-1123) Avail: NTIS HC A02/MF A01

The NOSPLOT reads the SC-4020 plot tapes output by the SCORS plotting package and plot selected frames on a Tektronix terminal under the CDC 6600's NOS 1 operating system. This feature enables SCORS users on the CDC 6600/7600 to examine their plots immediately rather than waiting until the next day. ERA

N78-26778*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
BASIC LINEAR ALGEBRA SUBPROGRAMS FOR FORTRAN USAGE
C. L. Lawson, R. J. Hanson (Sandia Labs, Albuquerque, N. Mex.), D. R. Kincaid (Texas Univ., Austin), and F. T. Krogh Oct. 1977 41 p refs
(Contract EY-76-C-04-0789)
(NASA-CR-156932; SAND-77-0898) Avail: NTIS HC A03/MF A01 CSCL 09B

A package of 38 low level subprograms for many of the basic operations of numerical linear algebra is presented. The package is intended to be used with FORTRAN. The operations in the package are dot products, elementary vector operations, Givens transformations, vector copy and swap, vector norms, vector scaling, and the indices of components of largest magnitude. The subprograms and a test driver are available in portable FORTRAN. Versions of the subprograms are also provided in assembly language for the IBM 360/67, the CDC 6600 and CDC 7600, and the Univac 1108. ERA

N78-26779# California Univ., Livermore. Lawrence Livermore Lab.
BBCPLOT USERS MANUAL
Ron F. Litterst Aug. 1977 16 p refs
(Contract W-7405-eng-48)
(UCID-17719) Avail: NTIS HC A02/MF A01

The BBCPLOT is a sophisticated graphics program which allows the user to analyze BBC data through the use of pictures. The raw data are supplied by either BBC restart dumps of Fractional Volume dumps, and the plots are produced by use of TV80LIB software. There are several types of pictures which the user can have as output from BBCPLOT. The most general type is the 2-D contour plot. This type of picture displays lines of equal value of data. Another type of picture is the arrow plot. In this picture an arrow is plotted in a zone to convey the information of direction and magnitude. Another type of picture is a three-dimensional surface plot. Instead of contour lines, the data are displayed as mountains and valleys. Also available are fractional Volume plots produced from BBCFV dumps and Profile SnapShot plots produced from BBC CRTSS dump files. Profiles, parallel to the Z or R axis, can be plotted on any of the acceptable variables. BBCPLOT exists on both the 7600 and STAR computers. GRA

N78-26780# California Univ., Livermore. Lawrence Livermore Lab.
DESIGN OF STABLE 2-D HALF-PLANE RECURSIVE FILTERS USING SPECTRAL FACTORIZATION
M. P. Ekstrom, R. E. Twogood, and J. W. Woods 16 Dec. 1977 5 p refs Presented at IEEE Itern. Conf. on Acoustics, Speech and Signal Processing, Tulsa, Okla., 10 Apr. 1978
(Contract W-7405-eng-48)
(UCRL-80078; Conf-780403-2) Avail: NTIS HC A02/MF A01

A new design algorithm for two-dimensional (2-D) recursive digital filters is presented, with emphasis on the the general class of halfplane filters. A recently developed 2-D spectral factorization procedure and a nonlinear optimization algorithm were incorporated for iterative convergence to a stable, (locally) optimum filter. Details of the computations required in the implementation of the design procedure are presented, in addition to an example of its application. ERA

N78-26264# General Motors Research Labs., Warren, Mich.
DIGITAL COMPUTER PROGRAM FOR SIMULATION OF A STIRLING CYCLE ENGINE
John R. Altenhoff *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 2: Stirling Cycle Anal. and Eng. Design Studies Apr. 1978 21 p (For availability see N78-26262 17-31)
(GMR-2690-Sect-2.102) Avail: NTIS HC A14/MF A01

62 COMPUTER SYSTEMS

Includes computer networks.

No abstracts in this category.

63 CYBERNETICS

Includes feedback and control theory.

For related information see also *54 Man/System Technology and Life Support.*

N78-26781*# Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.
ON RELIABLE CONTROL SYSTEM DESIGNS Ph.D. Thesis
John Douglas Birdwell May 1978 260 p refs
(Grants NGL-22-009-124; AF-AFOSR-3281-77)
(NASA-CR-157229; ESL-TH-821) Avail: NTIS HC A12/MF A01 CSCL 12B

A mathematical model for use in the design of reliable multivariable control systems is discussed with special emphasis on actuator failures and necessary actuator redundancy levels. The model consists of a linear time invariant discrete time dynamical system. Configuration changes in the system dynamics are governed by a Markov chain that includes transition probabilities from one configuration state to another. The performance index is a standard quadratic cost functional, over an infinite time interval. The actual system configuration can be deduced with a one step delay. The calculation of the optimal control law requires the solution of a set of highly coupled Riccati-like matrix difference equations. Results can be used for off-line studies relating the open loop dynamics, required performance, actuator mean time to failure, and functional or identical actuator redundancy, with and without feedback gain reconfiguration strategies. A.R.H.

N78-26782# Yale Univ., New Haven, Conn. Dept. of Engineering and Applied Science.
STABLE ADAPTIVE CONTROLLER DESIGN DIRECT CONTROL
Kumpati S. Narendra and Lena S. Valavani Mar. 1978 47 p refs Revised
(Contract N00014-76-C-0017)
(AD-A053314; S/IS-7706-Rev) Avail: NTIS HC A03/MF A01 CSCL 05/8

In this paper, the adaptive control problem for the case of an unknown plant with a single input and a single output is considered. The plant is assumed to be linear and time-invariant and a differentiator-free controller is to be designed to generate a control input u(t) so that the output of the plant evolves asymptotically towards that of a given model. GRA

N78-26783# Undersea Research Corp., Falls Church, Va.
DIRECT ELECTRONIC TRANSFORMS FOR FEATURE EXTRACTION Final Report, 2 Mar. 1977 - 1 Apr. 1978
Edward G. Kelliher 1 Apr. 1978 33 p refs
(Contract DAAK70-77-C-0049)
(AD-A053259; ETL-0139) Avail: NTIS HC A03/MF A01 CSCL 05/5

A description of a special purpose R and D system for performing direct two-dimensional Walsh transforms of images is described. The system is capable of obtaining 512-squared Walsh coefficients of two-dimensional images in approximately 10 seconds. Successful tests of the system's performance using simple images are also described. Author (GRA)

N78-26784# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
COMPUTER IDENTIFICATION OF PHONEMES IN CONTINUOUS SPEECH M.S. Thesis
Michael F. Guyote and Patrick L. Sisson Nov. 1977 158 p refs
(AD-A053268; AFIT/GE/EE/77D-18) Avail: NTIS HC A08/MF A01 CSCL 17/2

An approach to computer recognition of continuous speech through phoneme identification is presented. Speech data is digitally processed through correlation, recognition, and location programs. Methods of phoneme prototype production were explored including single and multiple speaker discrete and averaged prototypes. The identification process presents a rank ordering of probable phonemic occurrances at each time period. The method is used to attain an average recognition rate of 72% on continuous speech spoken by dissimilar speakers. Author (GRA)

N78-26785# Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
COMPUTER IMAGE SEGMENTATION: STRUCTURED MERGE STRATEGIES
R. A. Jarvis Dec. 1977 36 p refs
(Grant NSF ENG-76-18567)
(PB-277930/4; TR-EE77-44) Avail: NTIS HC A03/MF A01 CSCL 09B

Image segmentation is concerned with the spatial definition of visually coherent entities constituting a scene. An evaluation is done of a merge procedure for image segmentation built upon an image fragment data base that can be easily maintained during a sequence of merges. Some preliminary examples are presented and a number of comments on future work are made. GRA

N78-26786# Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Electrical and Systems Engineering.
A GENERALIZED LINE AND JUNCTION LABELLING

SCHEME WITH APPLICATIONS TO SCENE ANALYSIS
Indranil Chakravarty Dec. 1977 41 p refs
(Grant NSF ENG-76-02488)
(PB-278073/2; CRL-55) Avail: NTIS HC A03/MF A01 CSCL 09B

A line and junction labelling scheme is introduced that is valid for both planar and curved-surface bodies. Seven generalized junction types are defined and shown to cover all valid projections for a wide class of planar and curved-surface bodies. It is further shown that there are limitations on the permissible junction types as one moves from one end of a line segment to the other. The valid junction transitions provide a new set of edge semantics for line labelling. The labelling scheme classifies curved surface bodies into two categories: convex and concave. It can further be used to verify whether a given sequence of junctions can form a face. Certain junction transitions are shown to be attributable to only concave surfaces. The ability to classify regions as projections of planar, convex or concave surfaces (partially or fully visible) is used to gain a deeper understanding of line structures than was possible with previous labelling schemes.
GRA

N78-26787# ORI, Inc., Bethesda, Md.
STUDY OF THE EFFECTIVENESS OF OCR FOR DECENTRALIZED DATA CAPTURE AND CONVERSION Final Report, Jun. 1976 - Feb. 1978
David M. Liston, Jr. Feb. 1978 142 p
(Grant NSF DSI-76-14760)
(PB-277992/4; TR-1296) Avail: NTIS HC A07/MF A01 CSCL 09B

The ERIC network conversion to an OCR (Optical Character Recognition) mode of data entry was studied to analyze the potential effectiveness of OCR data entry for future EPC/s (Editorial Processing Centers). Study results are also applicable to any other system involving decentralized bibliographic data capture and conversion functions. The report does not recommend such OCR applications unless: All OCR keying can be done on standardized forms; consistent high quality of character images keyed on OCR forms can be maintained; and, suitable methods can be devised for coping with special notation (e.g., mathematical, chemical). The report contains performance data on both the OCR keying and OCR scanning functions, and provides a cost/savings analysis. Practical guidelines are provided for the implementation and operation of OCR data entry system. GRA

64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

N78-26788 Texas Univ. at Austin.
ON SOME APPROXIMATIONS ARISING IN THE GENERALIZED MASTER EQUATION DESCRIPTION OF DISCRETE OPEN SYSTEM MODELS Ph.D. Thesis
John William Middleton 1977 255 p
Avail: Univ. Microfilms Order No. 7807349

This work argues for a class of models in which a system of discrete levels is linearly coupled to a reservoir system composed of free bosons. The validity of the standard truncation is related to the assumption that the reservoir state is thermal (chaotic). This conclusion is reached by a formal proof that an infinite subclass of terms in the perturbation expansion of the kernel which generally give a nondecaying contribution to the kernel, vanish in the thermodynamic limit of the reservoir provided the reservoir state is factorized and diagonal in the boson occupation number representation. Dissert. Abstr.

N78-26789 California Univ., Davis.
VARIATIONAL CALCULATIONS FOR DENSITY MATRICES Ph.D. Thesis
James Michael Hannon 1977 359 p
Avail: Univ. Microfilms Order No. 7809230

Reduced state density matrices are defined in terms of partial traces of an ensemble density operator, D (where D is a nonnegative, hermitian operator of unit trace, representing the probabilities of finding a system in an ensemble in given (states). Reduced particle density matrices are defined as expectation values (over an ensemble) or products of creation and/or annihilation operators. Calculations were done for single particle bases consisting of 10 and 16 states. It was found that the energies computed from the two methods were essentially identical (indicating the sufficiency of the necessary conditions in this case), but the CI calculation required a substantially smaller amount of computer resources. Dissert. Abstr.

N78-26790 Cornell Univ., Ithaca, N. Y.
COMBINATORIAL ALGORITHMS IN CERTAIN CLASSES OF BINARY MATROIDS Ph.D. Thesis
Robert Tamari 1977 95 p
Avail: Univ. Microfilms Order No. 7807766

Basic concepts and terminology are reported for binary matroids that arise from column dependencies of matrices over the field of residues mod 2. Tutte's characterization of the geometry of a binary matroid was used to show that nodal circuits of a matroid are analogous to the vertices of a graph. An algorithm was developed for constructing a nodal circuit containing a specified element. Dissert. Abstr.

N78-26791 Virginia Polytechnic Inst. and State Univ., Blacksburg.
A NONLINEAR VOLTERRA EQUATION OF NONCONVOLUTION TYPE Ph.D. Thesis
Manfred Charles Smith 1977 50 p
Avail: Univ. Microfilms Order No. 7808120

The asymptotic behavior of bounded solutions x(t) of the integrodifferential x(t) plus the definite integral from o to t of a(t,tau)g(x(tau)) d tau = f(t) when this greater than or equal to o and less than infinity, and where a(t,tau) g(x) and f(t) are given real-valued functions. The existence of the limit of g(x(t)) as t approaches infinity is obtained and the restriction that minus a sub tau, t(t,tau) be weighted along tau = t is removed.
Dissert. Abstr.

N78-26792 Brown Univ., Providence, R. I.
ABDUCTION ALGORITHMS FOR GRAMMAR DISCOVERY Ph.D. Thesis
Stefan Shrier 1977 151 p
Avail: Univ. Microfilms Order No. 7809094

A model of language syntax acquisition is formulated as an inference problem: to guess the wiring diagram of an unreliable automation. A constructive method was developed which solved the grammatical inference problem via an abductory inductive process applied to the sample strings generated by the stochastic automation. The right invariant equivalence classes which corresponded to the states of the sought-for automation were established by the training sequence and a teacher. Several examples are used to illustrate the behavior of various algorithms which were developed to carry out the synthesis; among these is a fragment of English grammar. Dissert. Abstr.

N78-26793 Texas Univ. at Austin.
GALERKIN APPROXIMATION OF SOME NONLINEAR PARTIAL DIFFERENTIAL EQUATIONS MODELING LONG WAVES IN SHALLOW WATER Ph.D. Thesis
Martin Malcolm Rooney 1977 186 p
Avail: Univ. Microfilms Order No. 7807375

The nonlinear systems to which the discrete approximations to and the systems of Showalter ultimately reduce, are shown to have unique solutions if the step size in time is small enough. Several methods are given for their solution. An algorithm for the solution of linear systems from problems with periodic boundary conditions is given. Numerical comparisons of the wave models and comparisons of the Crank-Nicolson-Galerkin method to other numerical methods are done. It is shown that the computationally linear midpoint full finite difference method has high accuracy when there is little change in waveform.
Dissert. Abstr.

N78-26794 Brown Univ., Providence, R. I.
A FIXED POINT FORMULA FOR SINGULAR VARIETIES Ph.D. Thesis
George John Quart 1977 49 p
Avail: Univ. Microfilms Order No. 7809087

A localization theorem in algebraic K-theory is proven which completely solves the fixed point problem when f is an automor-

phism of a singular variety X, of finite order prime to the characteristic of k. When applied to nonsingular varieties, the formulas recapture those already cited of Atiyah-Bott, Atiyah-Segal, and Toledo-Tong, as well as those of Donovan and Nielsen. The techniques reveal a uniform character of the various fixed point formulas. In the case that X is singular, the formulas yield new and interesting algebraic and topological invariants for the study of singular varieties with endomorphisms, as well as a Lefschetz-Riemann-Roch theorem for singular varieties.

Dissert. Abstr.

N78-26795*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

ON IMPROVING THE ITERATIVE CONVERGENCE PROPERTIES OF AN IMPLICIT APPROXIMATE-FACTORIZATION FINITE DIFFERENCE ALGORITHM

Jean-Antoine Desideri (Iowa State Univ., Ames), J. L. Steger, and J. C. Tannehill (Iowa State Univ., Ames) Jun. 1978 121 p refs

(NCA2-OR340-706)

(NASA-TM-78495; A-7474) Avail: NTIS HC A06/MF A01 CSCL 12A

The iterative convergence properties of an approximate-factorization implicit finite-difference algorithm are analyzed both theoretically and numerically. Modifications to the base algorithm were made to remove the inconsistency in the original implementation of artificial dissipation. In this way, the steady-state solution became independent of the time-step, and much larger time-steps can be used stably. To accelerate the iterative convergence, large time-steps and a cyclic sequence of time-steps were used. For a model transonic flow problem governed by the Euler equations, convergence was achieved with 10 times fewer time-steps using the modified differencing scheme. A particular form of instability due to variable coefficients is also analyzed. Author

N78-26796*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

TECHNIQUES FOR CORRECTING APPROXIMATE FINITE DIFFERENCE SOLUTIONS

David Nixon Jun. 1978 19 p refs

(NASA-TM-78499; A-7491) Avail: NTIS HC A02/MF A01 CSCL 12A

A method of correcting finite-difference solutions for the effect of truncation error or the use of an approximate basic equation is presented. Applications to transonic flow problems are described and examples are given. Author

N78-26797*# National Aeronautics and Space Administration, Washington, D. C.

A GENERAL SPECTRAL TRANSFORMATION SIMULTANEOUSLY INCLUDING A FOURIER TRANSFORMATION AND A LAPLACE TRANSFORMATION

Hans Marko Jun. 1978 23 p refs Transl. into ENGLISH from Arch. Elektronik und Uebertragungstechnik (Germany), vol. 1, 31 Sep. 1977 p 363-370 Original language document was announced as A77-50667 Transl. by Kanner (Leo) Associates, Redwood City, Calif. Original doc. prep. by the Institute for Information Technology, Technical Univ. (Munich)

(Contract NASw-2790)

(NASA-TM-75316) Avail: NTIS HC A02/MF A01 CSCL 12A

A general spectral transformation is proposed and described. Its spectrum can be interpreted as a Fourier spectrum or a Laplace spectrum. The laws and functions of the method are discussed in comparison with the known transformations, and a sample application is shown. Author

N78-26798# Royal Aircraft Establishment, Farnborough (England).

RELAXATION METHODS FOR THE SOLUTION OF ELLIPTIC PROBLEMS IN DOMAINS WITH ARBITRARY BOUNDARIES. APPLICATIONS TO COMPUTATION OF SUBCRITICAL FLOWS

M. Fenain Jan. 1978 50 p refs Transl. into ENGLISH from J. de Mec. Appliquee (France), v. 1, no. 1, 1977

(RAE-Lib-Trans-1951; BR63014) Avail: NTIS HC A03/MF A01

A numerical solution is detailed for elliptic partial differential equations in single or multiple-connected domains with arbitrary boundaries. The simple and convenient technique of correction of the coefficients yielded a normalized scheme for the treatment of all the mesh-points, regardless of their proximity to the boundary and also of the type of boundary condition, whether of Dirichlet, Neumann or related type. Applications, pertinent to subcritical flows, are presented. Nonlinear fundamental equations were treated as linear non-homogeneous equations with an evolutive right-hand side. G.G.

N78-26799# Yale Univ., New Haven, Conn. Dept. of Computer Science.

CONJUGATE GRADIENT METHODS FOR PARTIAL DIFFERENTIAL EQUATIONS

Rati Chandra Jan. 1978 136 p refs

(Contracts N00014-76-C-0277; F49620-77-C-0037; EG-77-S-02-4349; Grant NSF MCS-76-11460)

(AD-A053313; PR-129) Avail: NTIS HC A07/MF A01 CSCL 12/1

The method of conjugate gradients is known as an efficient iterative method for solving large sparse symmetric positive definite systems of linear equations. Such systems arise frequently in scientific computing, as in the solution of self-adjoint elliptic partial differential equations using finite difference and finite element techniques. GRA

N78-26800# Naval Ocean Systems Center, San Diego, Calif.

MAXIMUM ENTROPY SPECTRAL ANALYSIS OF MULTIPLE SINUSOIDS IN NOISE Final Report, Feb. - Mar. 1977

E. H. Satorius and J. R. Zeidler 2 Apr. 1978 37 p refs

(AD-A053257; NOSC-TR-201) Avail: NTIS HC A03/MF A01 CSCL 12/1

In this paper an analytical technique based on the method of undetermined coefficients is applied to the problem of computing the theoretical maximum entropy (MEM) spectral estimate when the correlation function of the data is known exactly and corresponds to N sinusoids in additive white noise and to N sinusoids in additive 1 pole, low-pass noise. For the white noise case, the L prediction filter coeffecients are expanded directly in terms of the input sinusoids. This expansion leads to a transformation of the L x L normal equations for the prediction filter coefficients to a set of 2N x 2N equations. The transformed equations are a smaller set of equations to be solved whenever L = 2N and provide a convenient description of the interaction between the various frequency components of the sinusoids which occurs in the MEM estimate. Further, for certain cases where there is little interaction between some of the frequency components of the sinusoids, the solution of the 2N x 2N equations may be approximated (to zeroth order) by the solution of a smaller set of coupled equations. A better approximation to the exact solution of the 2N x 2N equations can then be obtained from a perturbation expansion of the exact solution about the zeroth order approximation. For the case of N sinusoids in 1 pole, low-pass noise, the L prediction filter coefficients are expanded in terms of the input sinusoids as well as two delta functions which occur at the beginning and end of the filter. This expansion also leads to a set of 2N x 2N equations. For this case the values of the MEM estimate evaluated at the frequencies of the sinusoids are shown to be a function of the frequencies of the sinusoids. GRA

N78-26801# Johns Hopkins Univ., Baltimore, Md.

CONSISTENCY OF A CLASS OF ROBUST ESTIMATORS OF CROSSCORRELATION Final Report

V. David VandeLinde 31 Mar. 1978 25 p refs

(Grant DAAG29-77-G-0093)

(AD-A053145; ARO-14688.1-R-M) Avail: NTIS HC A02/MF A01 CSCL 12/1

In a previous work, a class of non-linear recursive estimators of cross-correlation was shown through simulations to be robust in identifying the parameters of linear, stationary, single-input-single-output systems whose output measurements are contaminated by noise which is not completely specified: the measurement noise distribution f is given by F=(1-epsilon) K - epsilon C, where K is completely known and C belongs to the class of zero-mean, symmetric, finite variance distributions. The principal result of this report is a complement to these earlier results -- namely, a proof of consistency, with mean square convergence, for a general sub-class of the non-linear estimators of crosscorrela-

tion defined in the earlier work. The proof is along the same lines as those followed in the Robbins-Monro stochastic approximation method. GRA

N78-26802# Stanford Univ., Calif. Dept. of Operations Research.
DISCOVERING HIDDEN TOTALLY LEONTIEF SUBSTITUTION SYSTEMS
George B. Dantzig and Arthur F. Veinott, Jr. 20 Dec. 1977 10 p refs
(Contracts N00014-75-C-0493; N00014-75-C-0865; EY-76-S-03-0326; Grants NSF MCS-76-81259; NSF MCS-76-22019; NSF ENG-76-12266)
(AD-A053201; SU-TR-32) Avail: NTIS HC A02/MF A01 CSCL 12/1

A constructive procedure is given for determining the existence of and evaluating (when it does exist) a nonsingular matrix that transforms a system of linear equations in nonnegative variables into a totally Leontief substitution system. The computational effort involved is about that required to optimize the given m-row linear system with m-1 different linear objective functions. Author (GRA)

N78-26803# Army Research Office, Research Triangle Park, N. C.
TRANSACTIONS OF THE CONFERENCE OF ARMY MATHEMATICIANS (23RD)
Feb. 1978 657 p refs Conf. held at U.S. Army Mobility Research and Development Lab., Langley Research Center, Hampton, Virginia, 11-13 May 1977
(AD-A053266; ARO-78-1) Avail: NTIS HC A99/MF A01 CSCL 12/1

These conferences, which are sponsored by the Army Mathematics Steering Committee (AMSC), provide an opportunity for engineers, physicists and other scientists to get together with mathematicians to originate conceptual and analytic tools to treat problems in these various fields. GRA

N78-26804# California Univ., Livermore. Lawrence Livermore Lab.
MILESTONE REPORT: STRUCTURE THEORY
S. J. Hegner 12 Dec. 1977 35 p refs
(Contract W-7405-eng-48)
(UCID-17687) Avail: NTIS HC A03/MF A01

A theory of structure is developed based upon the concept of universal algebra. The concept of system syntax is based upon free algebras. The concept of system semantics is based upon homomorphisms from free algebras. Connections to the general theory of modeling and simulation are made. ERA

N78-26805# Stanford Univ., Calif. Computer Science Dept.
NEW PROOF OF GLOBAL CONVERGENCE FOR THE TRIDIAGONAL QL ALGORITHM
W. Hoffmann and B. N. Parlett (California Univ., Berkeley, Calif.) Oct. 1977 19 p refs
(Contracts EY-76-S-03-0326; N00014-76-C-0013)
(SU-326-P30-56; STAN-CS-77-634) Avail: NTIS HC A02/MF A01

By exploiting the relation of the QL algorithm to inverse iteration a proof of global convergence is obtained which is more conceptual and less computational than previous analyses. The proof uses a new, but simple, error estimate for the first step of inverse iteration. ERA

N78-26266# General Motors Research Labs., Warren, Mich.
MATHEMATICAL MODEL OF THIS STIRLING THERMAL ENGINE
Richard L. Justice and James E. Bennethum *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 2: Stirling Cycle Anal. and Eng. Design Studies Apr. 1978 7 p (For availability see N78-26262 17-31)
(GMR-2690-Sect-2.104) Avail: NTIS HC A14/MF A01

N78-26267# General Motors Research Labs., Warren, Mich.
AN ITERATIVE-FINITE DIFFERENCE SOLUTION OF THE DIFFERENTIAL EQUATIONS DESCRIBING THE STIRLING THERMAL ENGINE
James E. Bennethum *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 2: Stirling Cycle Anal. and Eng. Design Studies Apr. 1978 13 p (For availability see N78-26262 17-31)
(GMR-2690-Sect-2.105) Avail: NTIS HC A14/MF A01

N78-26268# General Motors Research Labs., Warren, Mich.
NUMERICAL TREATMENT OF A THIRD ORDER NONLINEAR HYPERBOLIC DIFFERENTIAL SYSTEM
Richard L. Justice *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 2: Stirling Cycle Anal. and Eng. Design Studies Apr. 1978 7 p refs (For availability see N78-26262 17-31)
(GMR-2690-Sect-2.106) Avail: NTIS HC A14/MF A01

65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

N78-26806 Princeton Univ., N. J.
SHIFT INVARIANCE UNDER LINEAR MODELS Ph.D. Thesis
Pierre Delfiner 1978 139 p
Avail: Univ. Microfilms Order No. 7807468

In linear models Y = Xbeta + U it is often assumed that Xbeta described all the structure contained in the data, while U is just a vector of uncorrelated residuals. But for prediction such an approach may result in a substantial loss of efficiency. Allowing for correlation among residuals, however, poses the problem of estimation of the covariance matric sigma of U, expecially when observations Y are not replicated. Simplifying assumptions on the structure of sigma are usually introduced, but even so, when both beta and sigma are unknown, estimates of sigma may be plagued by considerable biases. The two problems, estimation of beta and of sigma, were separated and attention was focused on that part of sigma that may be estimated on the basis of functions phi(Y) which are beta-invariant. Dissert. Abstr.

N78-26807 Virginia Polytechnic Inst. and State Univ., Blacksburg.
PROPERTIES OF COMPOSITE SAMPLING PROCEDURES Ph.D. Thesis
Robert Scott Elder 1977 169 p
Avail: Univ. Microfilms Order No. 7807211

Models are developed for sampling from segmented or nonsegmented lots, allowing for more than one finite composite, testing error, within-increment variability, or two subsampling stages. The result of each model is a formula expressing the variance of the estimator of mu sub x in terms of model parameters. Each such formula is contrasted with the corresponding formula derived from the customarily employed random effects linear model. Among the significant properties of composite sampling procedures derived are the following: (1) there is a (relative) upper bound on the variance of the estimator of mu sub x in a composite sampling procedure; (2) the variance of the estimator of mu sub x does not necessarily decrease as the number of increments per composite increases; (3) it is not necessary to form more than one composite to check for changes in parameter values from lot to lot. Dissert. Abstr.

N78-26808 California Univ., Riverside.
THE PREDICTION OF TRUE ALPHA LEVEL IN THE TWO SAMPLE t-TEST FOR INDEPENDENT GROUPS UNDER HETEROGENEITY OF VARIANCE, SKEWNESS AND KURTOSIS Ph.D. Thesis
Philip Barton Ender 1977 164 p
Avail: Univ. Microfilms Order No. 7808277

Random uniform variates were obtained using a shuffle generator. The random uniform variates were transformed into random normal variates which were then transformed into random Johnson variates using an algorithm. The random Johnson variates are distributed with known means, variances, skewness, and kurtosis. The data obtained was in the form of the proportion of Student's falling into the appropriate rejection regions. These values were than plotted in a series of graphs of the observed or true alpha level. Additionally, the observed alpha level served as the criterion variable in a series of stepwise multiple regression

analyses. The intent of the regression analyses was to derive regression equations in order to predict true alpha level.
Dissert. Abstr.

N78-26809 Texas Univ. at Austin.
EFFECTS OF VIOLATIONS OF ASSUMPTIONS ON THE POWER AND ROBUSTNESS OF THE F-TEST FOR EQUALITY OF MEANS USING FIXED EFFECTS LINEAR REGRESSION Ph.D. Thesis
Archie Allen George 1977 143 p
Avail: Univ. Microfilms Order No. 7807303

The effects of violations of assumptions on the test for equality of means using fixed effects analysis of variance have been thoroughly documented. A test for equality of means is also often conducted using a fixed effects linear regression model. The term linear regression model refers to a model of the form $E(Y) = a + bx$, where $E(Y)$ is the expected value of the dependent variable, a and b are the parameters of the model, and x is the value on the independent variable, which specifies the population from which the observation on the dependent variable is drawn. The hypothesis often tested using this model is that the expected value of Y is the same for all values of x, i.e., $b = 0$. The fundamental difference between the analysis of variance test and the regression test is that the latter makes the assumption that a constant difference exists between the means. One consequence of the use of the linear regression model is that the test for no difference between means utilizes a contrast which has one and N - 2 degrees of freedom, where N is the total number of observations. Dissert. Abstr.

N78-26810 North Texas State Univ., Denton.
BOUNDARY CONDITIONS OF SEVERAL VARIABLES RELATIVE TO THE ROBUSTNESS OF ANALYSIS OF VARIANCE UNDER VIOLATION OF THE ASSUMPTION OF HOMOGENEITY OF VARIANCES Ph.D. Thesis
Grady Monroe Grizzle 1977 108 p
Avail: Univ. Microfilms Order No. 7807836

A Monte Carlo simulation technique was employed in the generation of data. Through this technique, random samples from K normally distributed treatment populations with equal means were generated in such a manner to produce K samples with n subjects per treatment group. For each parametric combination of K, n, and Q, 2,000 independent samples were generated and the one-way analysis of variance F-test technique for determining equality of means performed. The analysis of variance F-test is robust when the number of treatment groups is less than seven and when the extreme ratio of variances is less than 1:5, but when the violation of the assumption is more severe or the number of treatment groups is seven or more, serious discrepancies between actual and nominal significance levels occur.
Dissert. Abstr.

N78-26811 North Carolina Univ. at Chapel Hill.
TESTS FOR FINITE PROPER MIXTURES OF DISTRIBUTIONS Ph.D. Thesis
Chin-Fei Hsu 1977 94 p
Avail: Univ. Microfilms Order No. 7807139

A number of hypothesis testing problems were investigated, which involve the common of deciding whether an observed sample can be regarded as coming from a mixture of two or more component distributions. A method of deriving test statistics based on minimizing a Kolmogorov-Smirnov statistic among mixtures of two known components is suggested and a computational algorithm is constructed. Properties of tests based on these statistics are studied using simulation procedures for some special cases. Dissert. Abstr.

N78-26812 Minnesota Univ., Minneapolis.
GOODNESS-OF-FIT STATISTICS FOR LARGE SPARSE MULTINOMIALS Ph.D. Thesis
Kenneth Joseph Koehler 1977 335 p
Avail: Univ. Microfilms Order No. 7809685

Monte Carlo methods are used to assess how accurately the asymptotic normal distributions approximate the distributions of the Pearson and likelihood ratio test statistics for moderate numbers of cells and moderate sample sizes. Monte Carlo methods are also used to evaluate the use of the asymptotic normal distributions to obtain inexpensive approximations for the power curves of the Pearson and likelihood ratio statistics. The asymptotic normal theory for the likelihood ratio statistics is extended to include tests for the goodness of fit for log-linear models in large, sparse contingency tables. A consistent estimate of the asymptotic standard deviation based on maximum likelihood estimates of the unknown parameters is derived. Additional estimates of the asymptotic mean and standard deviation are proposed. Dissert. Abstr.

N78-26813 Carnegie-Mellon Univ., Pittsburgh, Pa.
ESTIMATION OF MARKOV CHAIN PARAMETERS AND AN EXTENSION OF RECURSIVE ESTIMATION TECHNIQUES Ph.D. Thesis
Bor-Jiin Mao 1978 181 p
Avail: Univ. Microfilms Order No. 7807187

A simultaneous estimation method for the estimation of multinomial cell probabilities is used to estimate discrete time Markov chain transition probabilities. Estimators which are superior to the maximum likelihood estimators are found. These new estimators are compared with maximum likelihood estimators using both exact calculations and simulation. The estimators are also adapted to handle the case of continuous time Markov chain data. A comparison of the estimators is given using simulation. A classification problem is also presented which allows any finite state space and any convex loss function.
Dissert. Abstr.

N78-26814 Cornell Univ., Ithaca, N. Y.
EXOFFENDER POST RELEASE PERFORMANCE EVALUATION WITH RELATED THEORETICAL TOPICS IN VARIABLE SELECTION AND FOLLOWUP INTERVALS FOR REGRESSION MODELS USING GROUPED CENSORED SURVIVAL DATA Ph.D. Thesis
Russell Richard Barton 1978 222 p
Avail: Univ. Microfilms Order No. 78-09461

Two theoretical questions are considered: optimality properties of regression variable selection rules and the optimal location of a fixed number of interval endpoints for group data. These questions arose from a study of exoffender post-release performance. Average variable cost data are used to estimate marginal cost for a semi-Markov expenditures model of exoffender post-release behavior. An example using actual criminal justice system data is presented. A statistical failure rate model for exoffender performance is considered. A review of covariance models for censored response time is presented. Some optimal grouping results for exponentially distributed random variables are reviewed. These results are extended to cases of right-censoring, competing risk, and a simple exponential regression model. Dissert. Abstr.

N78-26815 Case Western Reserve Univ., Cleveland, Ohio.
ON TESTING AND ESTIMATING THE INTERACTION BETWEEN TREATMENTS AND ENVIRONMENTAL CONDITIONS IN BINOMIAL EXPERIMENTS: THE CASE OF N STATIONS Ph.D. Thesis
Timothy Zgonc 1978 65 p
Avail: Univ. Microfilms Order No. 7809306

Procedures for determining second order interaction in 2 x 2 x K tables with fixed marginals are reviewed including an asymptotic method which employs the variance stabilizing transformation in the case $K=2$. The latter is extended to the case K is greater than 2. A no interaction condition consisting of K-1 orthogonal contrasts of the log odds ratios are proposed and two sets of simultaneous confidence limits are derived for them. The intervals are based on the maximum likelihood estimates of the log ratios. A uniformly most valuable unbiased test is developed for each of the K-1 contrasts. Numerical results comparing the two sets of asymptotic intervals are included.
Dissert. Abstr.

N78-26816 Florida State Univ., Tallahassee.
DESIGNS WITH POLYNOMIAL TRENDS IN COMPLETE OR INCOMPLETE BLOCKS Ph.D. Thesis
Ching-Ming Yeh 1977 150 p
Avail: Univ. Microfilms Order No. 7808978

Compared are treatments applied to plots in b blocks of equal size in such a way that one treatment is applied to each plot and each treatment occurs at most once in a block, in the

presence of a common multidimensional polynomial trend of preselected order over plots within each block. An observation is assumed to consist of additive components: treatment effect, block effect, trend effect on the plot, and random error. The random errors have zero means, constant variances and are independent for different observations. The objective was to restrict the usual randomized assignment of treatments to plots within blocks in such a way as to eliminate the effects of the polynomial trend on treatment comparisons. The criterion proposed for the designs desired is that the treatment sum of squares is calculated as though trends were absent. Dissert. Abstr.

N78-26817 Stanford Univ., Calif.
SOME CONVERGENCE PROPERTIES OF k-NEAREST NEIGHBOR ESTIMATES Ph.D. Thesis
William Hayward Rogers 1978 118 p
Avail: Univ. Microfilms Order No. 7808833

The relevant theorems are proved with sufficient generality to permit straightforward application to regression and other nonparametric statistical problems which employ the k-nearest neighbor concept. The theory is worked out for the problem of testing whether two samples are independent and identically distributed from the same population. The test is consistent for all instances in which the two populations have different densities. Dissert. Abstr.

N78-26818 Pennsylvania State Univ., University Park.
UNIFIED COMPUTATIONAL METHODS FOR ANALYZING CATEGORICAL DATA Ph.D. Thesis
Del T. Scott 1977 134 p
Avail: Univ. Microfilms Order No. 7808421

A computational procedure is developed that allows Wald statistics to be easily calculated using any general linear models computer program that provides weighted least squares as an option. The theoretical justification for the method is given. This computational procedure allows the Wald and maximum likelihood methods to be combined and thereby parallels closely the well-known analysis of continuous linear models. Dissert. Abstr.

N78-26819 North Carolina Univ., Chapel Hill.
TWO TOPICS IN SEMI-MARKOV PROCESSES: 1. SEMI-MARKOV PROCESSES WHICH ARE FUNCTIONS OF MARKOV CHAINS. 2. ESTIMATION OF THE PARAMETERS OF A SEMI-MARKOV PROCESS FROM AGGREGATE DATA Ph.D. Thesis
Stanley Allen Shulman 1977 228 p
Avail: Univ. Microfilms Order No. 78-07163

Both discrete-time and continuous-time semi-Markov processes are studied for the case when a finite state semi-Markov process is a function of a finite state Markov chain. Results depended on the assumed holding-time distributions for the semi-Markov process. It was also found that a finite-state Markov chain is collapsible into a semi-Markov process when the fitted semi-Markov process is a function of a Markov chain, or when the fitted Markov chain is collapsible into a semi-Markov process. The problem of estimating the parameters of a semi-Markov model from aggregate data is also considered. The results are applied to data sets based on work histories of individuals in the rubber industry. Dissert. Abstr.

N78-26820 North Carolina Univ., Chapel Hill.
ANALYSIS OF RANDOMIZED BLOCKS DESIGNS BASED ON WEIGHTED RANKINGS Ph.D. Thesis
Claudio Sergio Hernan Silva Zamora 1977 172 p
Avail: Univ. Microfilms Order No. 7807164

Block-scores associated with the variability observed within each block can be successfully used to recover inter-block information in the analysis of randomized complete blocks (RCB) designs. A family of distribution-free tests can be generated by combining different measures of variability, different sets of block-scores and different sets of treatment-scores. The asymptotic null and non-null distributions of these tests are derived in this dissertation. Comparisons within such a family of tests and against parametric and non-parametric competitors are conducted for designs with small number of blocks using as criterion the expected significance level (ESL). Comparisons for large number of blocks are based on the asymptotic relative efficiency (ARE). Extensions to balanced incomplete blocks designs and groups of experiments are also considered. Dissert. Abstr.

N78-26821 Stanford Univ., Calif.
MATRIX ORTHOGONAL POLYNOMIALS, WITH APPLICATIONS TO AUTOREGRESSIVE MODELING AND LADDER FORMS Ph.D. Thesis
Augusto Cesar Gadelha Vieira 1978 210 p
Avail: Univ. Microfilms Order No. 7808858

The theory of matrix orthogonal polynomials on the unit circle provides a framework for modeling and filtering multivatiate time series. By considering a normalized form of recursions, a covariance function can be uniquely specified by a sequence of partial correlation or reflection matrix coefficients, each of which has singular values of magnitude less than one. The recursions can be regarded as performing a coprime factorization of a certain matrix function, and have application in network synthesis, seismic and speech signal analysis, and batch data processing. Dissert. Abstr.

N78-26822 Stanford Univ., Calif.
CONTRIBUTIONS TO THE THEORY OF ROBUST REGRESSION Ph.D. Thesis
Robert Allen Wesley 1978 90 p
Avail: Univ. Microfilms Order No. 78-08865

The problem as addressed by this paper is robustly estimating the regression parameters in the simple linear and general linear regression models. The basic estimator is an R-type estimator which shows an asymptotically normal distribution when the score function on which it is based is monotone. The main results of this paper fall into two categories. The first category contains results related to the asymptotic consistency of the estimator when it is based on nonmonotone scores. A theorem giving conditions under which such estimators are consistent is presented, along with a counterexample which shows that for such nonmonotone scores certain additional conditions involved in the theorem are necessary. The second main category of results addresses the lack of knowledge in general of the distribution of the errors in the regression model. An adaptive estimator is proposed and its asymptotic behavior is considered. Dissert. Abstr.

N78-26823 Stanford Univ., Calif.
TESTING FOR THE EFFECT OF THE COVARIATE ON A POISSON POINT PROCESS Ph.D. Thesis
Robert Allen Wolfe 1978 56 p
Avail: Univ. Microfilms Order No. 78-08866

Methods for testing for association between the rate of occurrence of events from a Poisson point process and the values of a suspected modulating variable are considered. For a particular Poisson probability model for the point process, an optimal asymptotic test is known. A more general conditional test is proposed which utilizes, locally, the Fisher information for the unconditional likelihood in a described sense; and which gives exact significance statements easily in the discrete time case. Alternative tests which are not fully efficient but which yield exact significance statements in the continuous time case are given. The efficiencies for a class of tests based on regression methods are derived. The efficiency loss involved with using values other than the values of the modulating variable is derived. Many of the methods are used in an example involving heart transplant rejection episodes. Dissert. Abstr.

N78-26824 Houston Univ., Tex.
CHARACTERIZATION OF LINEAR SUFFICIENT STATISTICS Ph.D. Thesis
Richard Alan Redner 1977 36 p
Avail: Univ. Microfilms Order No. 7808112

The continuous linear sufficient statistics for a dominated collection of measures on a Banach space are characterized. This is followed by a characterization of exponential families with emphasis on those measures on R to the nth power whose densities with respect to Lebesque measure are multivariate normal densities. Finally, the relation between Bayes sufficiency and sufficient statistics is studied. Dissert. Abstr.

N78-26825 Brown Univ., Providence, R. I.
MULTI-DIMENSIONAL STOCHASTIC POPULATION

MODELS Ph.D. Thesis
Paul Jeffrey Polansky 1977 95 p
Avail: Univ. Microfilms Order No. 7809086

Two interacting populations were modeled by stochastic differential equations, and the existence and uniqueness, path stability and moments of the solutions are analyzed. Considered are colonies undergoing Malthusian randomized growth, interacting through migration. Exact conditions for the moments and the paths to converge to zero or infinity were obtained. Randomness entered as demographic stochasticity so that populations may become extinct in finite time. The results on moments and paths are analogous to those obtained for one population by Feller for the continuous analogue of the classical discrete time and state branching process. Dissert. Abstr.

N78-26826# Los Alamos Scientific Lab., N. Mex.
CONDITIONED RANDOM WALK WITH APPLICATIONS
W. A. Beyer and M. S. Waterman Jan. 1978 20 p refs
(Contract W-7405-eng-36)
(LA-6990-MS) Avail: NTIS HC A02/MF A01

A random walk on the set of integers (0,1,2,...,N) with absorbing barriers at 0 and N is considered. Transition times from the points r (0 less than r less than N) are random variables with finite expectations that depend only on r. Mean time to absorption at N, D/sub r is presented, with the condition that the walk starts at r and is absorbed at N. A probability measure is put on the random walk histories. A difference equation with boundary values for D/sub r/ is deriveD. It is solved in the special case of a birth and death process with linear growth. Higher moments of the time to absorption are discussed. This problem is motivated by two mathematical models in biology, which are also discussed. ERA

N78-26827# Physics Lab. RVO-TNO, The Hague (Netherlands).
ESTIMATION OF THE ERROR RATE OF AN OPTIMAL M-CATEGORY CLASSIFIER
W. J. P. A. Verbeek Jul. 1977 43 p refs
(PhL-1977-35; TDCK-69636) Avail: NTIS HC A03/MF A01

The derivation and use of a pattern recognition rule, the distance weighted nearest neighbor (DWNN) rule, which is especially useful if a decision algorithm has to be generated from a small collection of prototype data is described. In that case a truly optimal classifier like the Bayes minimum error classifier cannot be found. Besides being a decision algorithm itself, the DWNN provides an estimate of Pe, the error rate of the Bayes classifier, which also makes it a very useful criterion for feature selection. Even if a Bayes classifier could be derived from a given statistical problem description, often the true Pe cannot be calculated and again the DWNN may find application as an estimator of Pe. Author (ESA)

N78-26828# Deutsches Geodaetisches Forschungsinstitut, Munich (West Germany).
BLOCK ADJUSTMENT FOR CALCULATION OF EXTENSIVE TACHYMETER RECORDINGS Ph.D. Theses - Tech. Hochschule Stuttgart [DIE BLOCKAUSGLEICHUNG ZUR BERECHNUNG UMFANGREICHER TACHYMETRISCHER AUFNAHMEN]
Klaus Krack Bayerische Akad. der Wiss. 1977 86 p refs In GERMAN
(Ser-C/Diss-231; ISBN-3-7696-9287-X) Avail: NTIS HC A05/MF A01

Problems of automatic tachymetry are dealt with. The accuracy of two computation methods, net and block adjustment, was investigated. The general error propagation law and stochastic model representations were applied. The result consists in variants and covariants of adjusted coordinates in units of the mean weight unit error. ESA

N78-26829# International Institute for Applied Systems Analysis, Laxenburg (Austria).
STOCHASTIC CONTROL FOR LINEAR DISCRETE-TIME DISTRIBUTED-LAG MODELS
W. Brian Arthur Aug. 1977 17 p refs
(IIASA-RR-77-18) Avail: NTIS HC A02/MF A01

Optimal estimation and control procedures for models with distributed-delay variables were derived. Topics dealt with include the distributed-lag problem; the equivalent problem and solution, optimal control policy, and optimal filter-smoother. It was concluded that the optimal control results are linear in the estimates of past states and control, and that an optimal filter-smoother obtains and updates these estimates in linear fashion. Gain-matrix calculations are faster here than in the usual high-dimensional methods, and the discrete-time results show close correspondence to those for the continuous-time case. ESA

66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

N78-26830# Wetenschappelijk en Technisch Documentatie-en Informatiecentrum voor de Krijgsmacht, The Hague (Netherlands).
OPERATIONS RESEARCH XVII O.R. 198 UP TO AND INCLUDING O.R. 209. A BIBLIOGRAPHY
Dec. 1976 73 p refs Partly in ENGLISH, GERMAN, FRENCH, and DUTCH
(TDCK-68433) Avail: NTIS HC A04/MF A01

The index contains titles of publications of the Survey Operations Research published in 1976. The titles of reports are designated by their TDCK number, the articles are numbered YOR. Theoretical studies include queueing problems, programming, games, information, optimum distribution of effort, and storage management. Management applications such as routing, systems analysis, and maintenance are dealt with, whereas military applications involve flight analysis, probability of hitting, weapon systems, logistics, aeronautics, and education. ESA

N78-26831# Air Force Military Personnel Center, Randolph AFB, Tex.
HOW TO SPEED UP YOUR TRANSPORTATION MODEL
T. M. Beatty Dec. 1977 22 p refs
(AD-A052905) Avail: NTIS HC A02/MF A01 CSCL 12/2

This report presents a new method to compute a more nearly optimal initial basic feasible solution for the Transportation Model. The integration of two techniques; (1) the Decision Index (DI) and (2) an Admissability Index (AI), have resulted in 50 to 75 percent reductions in computer run time required to derive an optimal solution. Author (GRA)

N78-26832# Mechanics Research, Inc., McLean, Va.
OCS ANALYTICAL MODEL Final Report, 1 Nov. 1976 - 30 Apr. 1977
Glen Robinson May 1977 224 p refs
(SDC/MRI-2345-017) Avail: NTIS HC A10/MF A01

The status of various U.S. outer continental shelf energy source locations is assessed, offshore wells in the Gulf of Mexico and the Santa Barbara Channel. A logic network was designed to describing the entire offshore development process from geological surveys to the delivery on oil and gas ashore. The completed model will include all present U.S. offshore activities. Weighing factors can then be applied to translate the model for each of the 17 frontier areas now considered worth exploring. ERA

67 THEORETICAL MATHEMATICS

Includes topology and number theory.

N78-26833 Rockefeller Univ., New York.
SCATTERING THEORY AND ORTHOGONAL POLYNOMIALS Ph.D. Thesis
Jeffrey Stephen Geronimo 1977 153 p
Avail: Univ. Microfilms Order No. 7808214

A set of two two term recurrence relations for polynomials orthogonal on the real line is presented. These recurrence relations play roles analogous to those satisfied by polynomials orthogonal on unit circle. With these recurrence formulas a Wronskian theorem is proved and the Christoffel-Darboux formula is derived. The

role of the analog Jost function in various properties of orthogonal polynomials is investigated. The techniques of inverse scattering theory are used to calculate asymptotic formulas for the orthogonal polynomials. Finally Szego's theorem on toeplitz and Hankel determinants is proved by using the recurrence formulas and some properties of the Jost function. Dissert. Abstr.

N78-26834 New York Univ., N. Y.
ABSTRACT FORCING AND APPLICATIONS Ph.D. Thesis
Jean-Pierre Keller 1977 149 p
Avail: Univ. Microfilms Order No. 7808538

Forcing is considered as a method for axiomatizing theories. Questions relating to consistency, completeness, deductive closure, and degree of unsolvability of these theories were investigated. Dissert. Abstr.

N78-26835 Brown Univ., Providence, R. I.
FUNCTION RINGS OF ALGEBRAIC VARIETIES Ph.D. Thesis
Christopher Allan Young 1977 57 p
Avail: Univ. Microfilms Order No. 7809103

This class of rings contains non-finitely generated and non-Noetherian rings. General properties of these function rings include a dense open sub-variety in the image of any variety, in particular in Spec Tau (V), for any variety V. This variety is chosen so that the complement has co-dimension 2 or more. If the variety V is quasi-affine then Krull's principal ideal theorem holds for Tau (V). Properties of sub-algebras of finitely generated domains are also studied. Dissert. Abstr.

N78-26836 North Carolina Univ. at Chapel Hill.
THE HOMOTOPY PROBLEM FOR PROJECTIVE MODULES Ph.D. Thesis
Robert Varley 1977 57 p
Avail: Univ. Microfilms Order No. 7807172

The description of projective A [T] - modules for a ring A is considered for the case of a ring A with normalization A and conductor I for which A/I is an Artin ring. For rank 1 projective modules, a description of Pic A [T]/Pic A is recovered from a statement of representability for a Picard functor. For higher rank, a criterion to reduce the problem to the rank 1 case is given. It is shown that if A is a reduced, seminormal Noetherian ring of dimension less than or equal to 2 with A/I Artin and A regular then projective A [T sub 1, ..., T sub n] -modules are extended from A. Dissert. Abstr.

70 PHYSICS (GENERAL)

For geophysics see *46 Geophysics*. For astrophysics see *90 Astrophysics*. For solar physics see *92 Solar physics*.

N78-26837*# Princeton Univ., N. J.
PARTIALLY IONIZED PLASMAS, INCLUDING THE THIRD SYMPOSIUM ON URANIUM PLASMAS
M. Krishnan Washington, D. C. NASA Sep. 1976 297 p refs Presented at the 133rd Meeting of the Princeton Univ. Conf., Princeton, N. J., 10-12 Jun. 1976
(Grant NGL-31-001-005)
(NASA-CR-157047) Avail: NTIS HC A13/MF A01 CSCL 20I

Fundamentals of both electrically and fission generated plasmas are discussed. Research in gaseous fuel reactors using uranium hexafluoride is described and other partially ionized plasma applications are discussed. For individual titles, see N78-26838 through N78-26870.

N78-26838*# Princeton Univ., N. J.
ON THE EMISSION MECHANISM IN HIGH CURRENT HOLLOW CATHODE ARCS c75
M. Krishnan *In its* Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 8-23 refs (For availability see N78-26837 17-70)
Avail: NTIS HC A13/MF A01 CSCL 20I

Large hollow cathodes have been operated in a magnetoplasmadynamic arc over wide ranges of current and mass flow, with orifice current densities and mass fluxes encompassing those encountered in low current steady state hollow cathode arcs. Detailed cathode interior measurements of current and potential distributions show that maximum current penetration into the cathode is about one diameter axially upstream from the tip, with peak inner surface current attachment up to one cathode diameter upstream of the tip. The spontaneous attachment of peak current upstream of the cathode tip is suggested as a criterion for characteristic hollow cathode operation. This empirical criterion was verified by experiment. P.R.A.

N78-26839*# Princeton Univ., N. J.
A SCALING LAW FOR ENERGY TRANSFER BY INELASTIC ELECTRON-MOLECULE COLLISIONS IN MIXTURES c75
George K. Bienkowski *In its* Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 24-31 refs (For availability see N78-26837 17-70)
Avail: NTIS HC A13/MF A01 CSCL 20I

The equation governing the electron energy distribution in the presence of a spatially uniform electric field in a weakly ionized gas was reformulated into an integral equation for the logarithmic slope of the distribution function. For gas mixtures in which the dominant electron energy loss mechanism is by vibrational excitation of the molecules, this equation is suitable for approximate analysis and exact numerical solution by iteration. Superelastic collisions are easily included in this formulation, and do not seriously effect the convergence of the numerical scheme. The approximate analytical results are only qualitatively correct, but suggest appropriate parameters which correlate the exact numerical results very well. The distribution function as well as certain gross properties such as net energy transfer into vibration, mean energy, and drift velocity depend primarily on a single nondimensional parameter involving only E/N and the cross sections. P.R.A.

N78-26840*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PULSER-SUSTAINER GLOW DISCHARGE OPERATION IN STATIC CARBON MONOXIDE LASER MIXTURES c75
Daryl J. Monson and Craig M. Lee *In* Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 32-36 refs (For availability see N78-26837 17-70)
Avail: NTIS HC A13/MF A01 CSCL 20I

Successful operation of the pulser-sustainer concept is reported in large volume static room temperature CO laser mixes. High voltage pulses and ultraviolet sparks at 33 kHz combined with a separate low voltage sustainer electric field produce spatially uniform plasmas in a 3.0 liter volume. Completely independent control of ne and E/N is demonstrated. The tests are preliminary to testing of the concept in supersonic flow. P.R.A.

N78-26841*# Colorado State Univ., Fort Collins. Dept. of Mechanical Engineering and Physics.
PLASMA RESEARCH IN ELECTRIC PROPULSION AT COLORADO STATE UNIVERSITY c75
Paul J. Wilbur and Harold R. Kaufman *In* Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 37-47 refs (For availability see N78-26837 17-70)
Avail: NTIS HC A13/MF A01 CSCL 20I

The effect of electron bombardment ion thruster magnetic field configurations on the uniformity of the plasma density and the ion beam current density are discussed. The optimum configuration is a right circular cylinder which has significant fields at its outer radii and one end but is nearly field free within the cylinder and at the extraction grid end. The production and loss of the doubly charged ions which effect sputtering damage within thrusters are modeled and the model is verified for the mercury propellant case. Electron bombardment of singly charged ions is found to be the dominant double ion production mechanism. The low density plasma (approx. one million elec/cubic centimeter which exists in the region outside of the beam of thrust producing ions which are drawn from the discharge chamber is discussed. This plasma is modeled by assuming the ions contained in it are generated by a charge exchange process in the ion beam itself. The theoretical predictions of this model are shown to agree with experimental measurements. Author

N78-26842*# Politecnico di Milano (Italy). Dept. of Nuclear Engineering.
AN EFFICIENT PROCEDURE FOR COMPUTING PARTIAL IONIZATION OF A GAS IN NUMERICAL FLUID DYNAMICS **c75**
S. Garribba and L. Quartapelle (EURATOM, Ispra) *In* Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 48-51 refs (For availability see N78-26837 17-70)
(Contract EURATOM-109-73-PIPGI)
Avail: NTIS HC A13/MF A01 CSCL 20I

A numerical procedure is described that allows efficient solution for the three nonlinear and implicit equations of state relating the equilibrium properties of a partially (and singly) ionized neutral gas. In the computation, the values for the intensive variables, that is pressure, temperature and ionization coefficient, are iteratively obtained with a given accuracy starting from assigned values for energy and volume per unit mass. Iterative computation is performed only when the value for the ionization coefficient lies within the lower and the upper bounds fixed by the required number of significant digits; otherwise the two explicit equations of state for nonionized or for fully ionized gases are employed. P.R.A.

N78-26843*# North Carolina State Univ., Raleigh. Dept. of Mechanical and Aerospace Engineering.
ANALYSIS OF NUCLEAR INDUCED PLASMAS **c75**
Jerry E. Deese and H. A. Hassan *In* Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 52-63 refs (For availability see N78-26837 17-70)
(Grant NsG-1058)
Avail: NTIS HC A13/MF A01 CSCL 20I

A kinetic model is developed for a plasma generated by fission fragments and the results are employed to study He plasma generated in a tube coated with fissionable material. Because both the heavy particles and electrons play important roles in creating the plasma, their effects are considered simultaneously. The calculations are carried out for a range of neutron fluxes and pressures. In general, the predictions of the theory are in good agreement with available intensity measurements. Moreover, the theory predicts the experimentally measured inversions. However, the calculated gain coefficients are such that lasing is not expected to take place in a helium plasma generated by fission fragments. Author

N78-26844*# Illinois Univ., Urbana. Nuclear Engineering Program.
ENERGY DISTRIBUTIONS AND RADIATION TRANSPORT IN URANIUM PLASMAS **c75**
G. H. Miley, C. Bathke, E. Maceda, and C. Choi *In* Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 64-72 refs (For availability see N78-26837 17-70)
(Grant NsG-1063)
Avail: NTIS HC A13/MF A01 CSCL 20I

An approximate analytic model, based on continuous electron slowing, has been used for survey calculations. Where more accuracy is required, a Monte Carlo technique is used which combines an analytic representation of Coulombic collisions with a random walk treatment of inelastic collisions. The calculated electron distributions have been incorporated into another code that evaluates both the excited atomic state densities within the plasma and the radiative flux emitted from the plasma. P.R.A.

N78-26845*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
RECENT MEASUREMENTS CONCERNING URANIUM HEXAFLUORIDE-ELECTRON COLLISION PROCESSES **c75**
S. Trajmar, A. Chutjian, S. Srivastava, W. Williams, and D. C. Cartwright (LASL) *In* Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 73-79 refs (For availability see N78-26837 17-70)
(Contract NAS7-100; ERDA Order LS-76-5)
Avail: NTIS HC A13/MF A01 CSCL 20I

Scattering of electrons by UF6 molecules was studied at impact energies ranging from 5 to 100 eV and momentum transfer, elastic and inelastic scattering cross sections were determined. The measurements also yielded spectroscopic information which made possible to extend the optical absorption cross sections from 2000 angstroms to 435 angstroms. It was found that UF6 is a very strong absorber in the vacuum UV region. No transitions were found to lie below the onset of the optically detected 3.0 eV feature. Author

N78-26846*# Florida Univ., Gainesville.
MEASUREMENT TECHNIQUES FOR ANALYSIS OF FISSION FRAGMENT EXCITED GASES **c75**
R. T. Schneider, E. E. Carroll, J. F. Davis, R. N. Davie, T. C. Maguire, and R. G. Shipman *In* Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 80-90 refs (For availability see N78-26837 17-70)
Avail: NTIS HC A13/MF A01 CSCL 20I

Spectroscopic analysis of fission fragment excited He, Ar, Xe, N2, Ne, Ar-N2, and Ne-N2 have been conducted. Boltzmann plot analysis of He, Ar and Xe have indicated a nonequilibrium, recombining plasma, and population inversions have been found in these gases. The observed radiating species in helium have been adequately described by a simple kinetic model. A more extensive model for argon, nitrogen and Ar-N2 mixtures was developed which adequately describes the energy flow in the system and compares favorably with experimental measurements. The kinetic processes involved in these systems are discussed. P.R.A.

N78-26847*# Illinois Univ., Urbana-Champaign. Nuclear Engineering Program and Gaseous Electronics Lab.
THE PUMPING MECHANISM FOR THE NEON-NITROGEN NUCLEAR EXCITED LASER **c36**
G. W. Cooper, J. T. Verdeyen, W. E. Wells, and G. H. Miley *In* Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 91-101 refs (For availability see N78-26837 17-70)
Avail: NTIS HC A13/MF A01 CSCL 20E

In order to determine the physical processes for pumping this laser, a detailed study of the afterglow system has been performed. The pumping mechanism has been found to be collisional-radiative electron-ion recombination. Microwave quenching of both the laser and spontaneous afterglow light have shown conclusively that a recombination process directly produces a nitrogen atom in either the upper laser level or, more likely, in a higher lying energy level which rapidly de-excites to the upper laser level. P.R.A.

N78-26848*# Illinois Univ., Urbana. Nuclear Engineering Program.
RECENT NUCLEAR PUMPED LASER RESULTS **c36**
G. H. Miley, W. E. Wells, M. A. Akerman, and J. H. Anderson *In* Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 102-108 refs Sponsored in part by DOE (For availability see N78-26837 17-70)
Avail: NTIS HC A13/MF A01 CSCL 20E

Recent direct nuclear pumped laser research has concentrated on experiments with three gas mixtures (Ne-N2, He-Ne-O2, and He-Hg). One mixture has been made to lase and gain has been achieved with the other two. All three of these mixtures are discussed with particular attention paid to He-Hg. Of interest is the 6150-angstroms ion transition in Hg(+). The upper state of this transition is formed directly by charge transfer and by Penning ionization. P.R.A.

N78-26849*# Stanford Research Inst., Menlo Park, Calif. Molecular Physics Center.
NUCLEAR FISSION FRAGMENT EXCITATION OF ELECTRONIC TRANSITION LASER MEDIA **c36**
D. C. Lorents, M. V. McCusker, and C. K. Rhodes *In* Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 109-114 refs (For availability see N78-26837 17-70)
Avail: NTIS HC A13/MF A01 CSCL 20E

Specific characteristics of the media including density, excitation rates, wavelength, kinetics, fissile material, scale size, and medium uniformity are assessed. The use of epithermal neutrons, homogeneously mixed fissile material, and special high cross section nuclear isotopes to optimize coupling of the energy to the medium are shown to be important considerations

maximizing the scale size, energy deposition, and medium uniformity. It is demonstrated that e-beam excitation can be used to simulate nuclear pumping conditions to facilitate the search for candidate media. P.R.A.

N78-26850*# Sandia Labs., Albuquerque, N. Mex.
DEVELOPMENT OF A HIGHER POWER FISSION-FRAGMENT-EXCITED CO LASER c36
D. A. McArthur *In* Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 115-122 refs Sponsored in part by DOE (For availability see N78-26837 17-70)
Avail: NTIS HC A13/MF A01 CSCL 20E

Moderate dilution of the CO with Ar lowers the reactor excitation threshold for lasing. Fission coatings on ceramic substrates have been developed which minimize fouling of laser mirrors. A new laser apparatus was constructed which more closely resembles large electrically excited CO lasers. Measurements of the energy emerging from the foils indicate that excitation of the gas is still below optimum values. Laser action at room temperature has also been observed. P.R.A.

N78-26851*# Illinois Inst. of Tech., Chicago.
REVIEW OF COAXIAL FLOW GAS CORE NUCLEAR ROCKET FLUID MECHANICS c73
Herbert Weinstein *In* Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 123-135 refs (For availability see N78-26837 17-70)
(Grant NsG-7039)
Avail: NTIS HC A13/MF A01 CSCL 21F

The two areas where discussion and comparison of work is most useful are in (1) the factors which influence containment in cold flow studies; and (2) the effects of heat generation on containment. The work in these areas have not received any critical review in the past. The review is structured in such a way as to compare and contrast the related work of the program, rather than to preserve the chronological order of the work. P.R.A.

N78-26852*# United Technologies Research Center, East Hartford, Conn. Fluid Dynamics Lab.
PROPERTIES OF RADIO-FREQUENCY HEATED ARGON CONFINED URANIUM PLASMAS c75
In Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 136-145 refs (For availability see N78-26837 17-70)
(Contract NAS1-13291)
Avail: NTIS HC A13/MF A01 CSCL 20I

Pure uranium hexafluoride (UF6) was injected into an argon confined, steady state, rf-heated plasma within a fused silica peripheral wall test chamber. Exploratory tests conducted using an 80 kW rf facility and different test chamber flow configurations permitted selection of the configuration demonstrating the best confinement characteristics and minimum uranium compound wall coating. The overall test results demonstrated applicable flow schemes and associated diagnostic techniques were developed for the fluid mechanical confinement and characterization of uranium within an rf plasma discharge when pure UF6 is injected for long test times into an argon-confined, high-temperature, high-pressure, rf-heated plasma. P.R.A.

N78-26853*# United Technologies Research Center, East Hartford, Conn.
THE EMISSION CHARACTERISTICS OF URANIUM HEXAFLUORIDE AT HIGH TEMPERATURES c72
N. L. Krascella *In* Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 146-155 refs (For availability see N78-26837 17-70)
(Contract NAS1-13291)
Avail: NTIS HC A13/MF A01 CSCL 20H

Relative emission measurements were made for UF6/Argon mixtures heated in a plasma torch over a range of temperatures from 800 to about 3600 K over a wavelength range from 80 to 600 nm. Total pressures were varied from 1 to approximately 1.7 atm. Similarly absorption measurements were carried out in the visible region from 420 to 580 nm over a temperature range from about 1000 to 1800 K. Total pressure for these measurements was 1.0 atm. The emission results exhibited relatively no emission at wavelengths below 250 nm over the range of temperatures investigated. At temperatures in excess of 1800 K an additional emission band centered at 310 nm appears and becomes more well defined at higher temperatures. Essentially no pressure effect was observed with respect to emission at pressures up to 1.7 atm. P.R.A.

N78-26854*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
URANIUM PLASMA EMISSION AT GAS-CORE REACTION CONDITIONS c75
M. D. Williams, N. W. Jalufka, F. Hohl, and J. H. Lee (Vanderbilt Univ.) *In* Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 156-159 refs (For availability see N78-26837 17-70)
Avail: NTIS HC A13/MF A01 CSCL 20I

The results of uranium plasma emission produced by two methods are reported. For the first method a ruby laser was focused on the surface of a pure U-238 sample to create a plasma plume with a peak plasma density of about 10 to the 20th power/cu cm and a temperature of about 38,600 K. The absolute intensity of the emitted radiation, covering the range from 300 to 7000 A was measured. For the second method, the uranium plasma was produced in a 20 kilovolt, 25 kilojoule plasma-focus device. The 2.5 MeV neutrons from the D-D reaction in the plasma focus are moderated by polyethylene and induce fissions in the U-235. Spectra of both uranium plasmas were obtained over the range from 30 to 9000 A. Because of the low fission yield the energy input due to fissions is very small compared to the total energy in the plasma. Author

N78-26855*# Brookhaven National Lab., Upton, N. Y.
STUDIES ON COLOR-CENTER FORMATION IN GLASS UTILIZING MEASUREMENTS MADE DURING 1 TO 3 MeV ELECTRON IRRADIATION c73
K. J. Swyler and P. W. Levy *In* Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 160-169 refs Sponsored in part by DOE (For availability see N78-26837 17-70)
(BNL-21531) Avail: NTIS HC A13/MF A01 CSCL 20H

The coloring of NBS 710 glass was studied using a facility for making optical absorption measurements during and after electron irradiation. The induced absorption contains three Gaussian shaped bands. The color center growth curves contain two saturating exponential and one linear components. After irradiation the coloring decays can be described by three decreasing exponentials. At room temperature both the coloring curve plateau and coloring rate increases with increasing dose rate. Coloring measurements made at fixed dose rate but at increasing temperature indicate: (1) The coloring curve plateau decreases with increasing temperature and coloring is barely measurable near 400 C. (2) The plateau is reached more rapidly as the temperature increases. (3) The decay occurring after irradiation cannot be described by Arrhenius kinetics. At each temperature the coloring can be explained by simple kinetics. The temperature dependence of the decay can be explained if it is assumed that the thermal untrapping is controlled by a distribution of activation energies. Author

N78-26856*# Princeton Univ., N. J. Plasma Physics Lab.
HEAT TRANSFER EVALUATION IN A PLASMA CORE REACTOR c75
Donald E. Smith, Timothy M. Smith, and Maria L. Stoenescu *In its* Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 170-177 (For availability see N78-26837 17-70)
Avail: NTIS HC A13/MF A01 CSCL 20I

Numerical evaluations of heat transfer in a fissioning uranium plasma core reactor cavity, operating with seeded hydrogen propellant, was performed. A two-dimensional analysis is based on an assumed flow pattern and cavity wall heat exchange rate. Various iterative schemes were required by the nature of the radiative field and by the solid seed vaporization. Approximate formulations of the radiative heat flux are generally used, due to the complexity of the solution of a rigorously formulated problem. The present work analyzes the sensitivity of the results with respect to approximations of the radiative field, geometry, seed vaporization coefficients and flow pattern. The results present

temperature, heat flux, density and optical depth distributions in the reactor cavity, acceptable simplifying assumptions, and iterative schemes. The present calculations, performed in cartesian and spherical coordinates, are applicable to any most general heat transfer problem. Author

N78-26857*# Los Alamos Scientific Lab., N. Mex.
RESEARCH ON PLASMA CORE REACTORS c75
G. A. Jarvis, D. M. Barton, H. H. Helmick, William Bernard, and R. H. White *In* Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 178-187 refs (For availability see N78-26837 17-70)
(Contract NASw-13755)
Avail: NTIS HC A13/MF A01 CSCL 20I

Experiments and theoretical studies are being conducted for NASA on critical assemblies with one-meter diameter by one-meter long low-density cores surrounded by a thick beryllium reflector. These assemblies make extensive use of existing nuclear propulsion reactor components, facilities, and instrumentation. Due to excessive porosity in the reflector, the initial critical mass was 19 kg U(93.2). Addition of a 17 cm thick by 89 cm diameter beryllium flux trap in the cavity reduced the critical mass to 7 kg when all the uranium was in the zone just outside the flux trap. A mockup aluminum UF6 container was placed inside the flux trap and fueled with uranium-graphite elements. Fission distributions and reactivity worths of fuel and structural materials were measured. Finally, an 85,000 cu cm aluminum canister in the central region was fueled with UF6 gas and fission density distributions determined. These results are to be used to guide the design of a prototype plasma core reactor which will test energy removal by optical radiation. Author

N78-26858*# United Technologies Research Center, East Hartford, Conn.
PARAMETRIC ANALYSES OF PLANNED FLOWING URANIUM HEXAFLUORIDE CRITICAL EXPERIMENTS c73
R. J. Rodgers and T. S. Latham *In* Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 188-196 refs (For availability see N78-26837 17-70)
(Contract XP5-54474-1)
Avail: NTIS HC A13/MF A01 CSCL 18K

Analytical investigations were conducted to determine preliminary design and operating characteristics of flowing uranium hexafluoride (UF6) gaseous nuclear reactor experiments in which a hybrid core configuration comprised of UF6 gas and a region of solid fuel will be employed. The investigations are part of a planned program to perform a series of experiments of increasing performance, culminating in an approximately 5 MW fissioning uranium plasma experiment. A preliminary design is described for an argon buffer gas confined, UF6 flow loop system for future use in flowing critical experiments. Initial calculations to estimate the operating characteristics of the gaseous fissioning UF6 in a confined flow test at a pressure of 4 atm, indicate temperature increases of approximately 100 and 1000 K in the UF6 may be obtained for total test power levels of 100 kW and 1 MW for test times of 320 and 32 sec, respectively. G.Y.

N78-26859*# United Technologies Research Center, East Hartford, Conn. Power Systems Technology Section.
CIRCULATION SYSTEM FOR FLOWING URANIUM HEXAFLUORIDE CAVITY REACTOR EXPERIMENTS c73
J. F. Jaminet and J. S. Kendall *In* Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 197-204 refs (For availability see N78-26837 17-70)
(Contracts XP4-54459-1; XP5-54474-1)
Avail: NTIS HC A13/MF A01 CSCL 18K

Research related to determining the feasibility of producing continuous power from fissile fuel in the gaseous state is presented. The development of three laboratory-scale flow systems for handling gaseous UF6 at temperatures up to 500 K, pressure up to approximately 40 atm, and continuous flow rates up to approximately 50g/s is presented. A UF6 handling system fabricated for static critical tests currently being conducted is described. The system was designed to supply UF6 to a double-walled aluminum core canister assembly at temperatures between 300 K and 400 K and pressure up to 4 atm. A second UF6 handling system designed to provide a circulating flow of up to 50g/s of gaseous UF6 in a closed-loop through a double-walled aluminum core canister with controlled temperature and pressure is described. Data from flow tests using UF6 and UF6/He mixtures with this system at flow rates up to approximately 12g/s and pressure up to 4 atm are presented. A third UF6 handling system fabricated to provide a continuous flow of UF6 at flow rates up to 5g/s and at pressures up to 40 atm for use in rf-heated, uranium plasma confinement experiments is described. Author

N78-26860*# United Technologies Research Center, East Hartford, Conn. Power Systems Technology Section.
MEASUREMENTS OF URANIUM MASS CONFINED IN HIGH DENSITY PLASMAS c75
R. C. Stoeffler *In* Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 205-210 refs (For availability see N78-26837 17-70)
(Contract NAS1-13291)
Avail: NTIS HC A13/MF A01 CSCL 20I

An X-ray absorption method for measuring the amount of uranium confined in high density, rf-heated uranium plasmas is described. A comparison of measured absorption of 8 keV X-rays with absorption calculated using Beer Law indicated that the method could be used to measure uranium densities from 3 times 10 to the 16th power atoms/cu cm to 5 times 10 to the 18th power atoms/cu cm. Tests were conducted to measure the density of uranium in an rf-heated argon plasma with UF6 infection and with the power to maintain the discharge supplied by a 1.2 MW rf induction heater facility. The uranium density was measured as the flow rate through the test chamber was varied. A maximum uranium density of 3.85 times 10 to the 17th power atoms/cu cm was measured. Author

N78-26861*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MAGNETOPLASMADYNAMIC THRUSTER APPLICATIONS c20
E. V. Pawlik *In* Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 211-216 refs (For availability see N78-26837 17-70)
(Contract NAS7-100)
Avail: NTIS HC A13/MF A01 CSCL 21C

Advance study activities within NASA indicate that electric propulsion will be required to make certain types of potential missions feasible. The large power levels under consideration make magnetoplasmadynamic thrusters a good candidate for these applications since this type of electric thruster is best suited to operation at high power levels. This paper examines the status of the magnetoplasmadynamic thruster and compares it to the ion thruster which also is a candidate. The use of these two types of electric propulsion devices for orbit raising of a self-powered large satellite is examined from a cost standpoint. In addition the use of nuclear electric propulsion is described for use as both a near-earth space tug and for an interplanetary exploration vehicle. These preliminary examinations indicate that the magnetoplasmadynamic thruster is the lowest cost thruster and therefore merits serious consideration for these applications. Author

N78-26862*# Princeton Univ., N. J.
MINI-CAVITY PLASMA CORE REACTORS FOR DUAL-MODE SPACE NUCLEAR POWER/PROPULSION SYSTEMS M.S. Thesis c20
Stanley Chow *In its* Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 217-223 refs (For availability see N78-26837 17-70)
(Grant NGR-31-001-328)
Avail: NTIS HC A13/MF A01 CSCL 21F

A mini-cavity plasma core reactor is investigated for potential use in a dual-mode space power and propulsion system. In the propulsive mode, hydrogen propellant is injected radially inward through the reactor solid regions and into the cavity. The propellant is heated by both solid driver fuel elements surrounding the cavity and uranium plasma before it is exhausted out the nozzle. The propellant only removes a fraction of the driver power, the remainder is transferred by a coolant fluid to a power conversion system, which incorporates a radiator for heat rejection.

Neutronic feasibility of dual mode operation and smaller reactor sizes than those previously investigated are shown to be possible. A heat transfer analysis of one such reactor shows that the dual-mode concept is applicable when power generation mode thermal power levels are within the same order of magnitude as direct thrust mode thermal power levels. Author

N78-26863*# United Technologies Research Center, East Hartford, Conn.
PLASMA CORE REACTOR APPLICATIONS c75
T. S. Latham and R. J. Rodgers *In* Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 224-238 refs (For availability see N78-26837 17-70)
(Contract NAS1-13291)
Avail: NTIS HC A13/MF A01 CSCL 20I

Analytical and experimental investigations were conducted to demonstrate the feasibility of fissioning uranium plasma core reactors and to characterize space and terrestrial applications for such reactors. Uranium hexafluoride fuel is injected into core cavities and confined away from the surface by argon buffer gas injected tangentially from the peripheral walls. Radiant heat transfer calculations were performed for a six-cavity reactor configuration. Axial working fluid channels are located along a fraction of each cavity peripheral wall. Results of calculations for outward-directed radiant energy fluxes corresponding to radiating temperatures of 2000 to 5000 K indicate total operating pressures from 80 to 650 atm, centerline temperatures from 6900 to 30,000 K, and total radiated powers from 25 to 2500 MW, respectively. Applications are described for this type of reactor such as (1) high-thrust, high specific impulse space propulsion, (2) highly efficient systems for generation of electricity, and (3) hydrogen or synthetic fuel production systems using the intense radiant energy fluxes. Author

N78-26864*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
BROADBAND PHOTOEXCITATION OF LASERS c36
R. V. Hess, A. Javan (Mass. Inst. of Tech., Cambridge), and P. Brockman *In* Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 239-243 refs (For availability see N78-26837 17-70)
Avail: NTIS HC A13/MF A01 CSCL 20E

Existing techniques are reviewed and novel approaches for broadband photoexcitation of lasers are discussed. This subject is of interest because of the emergence of future intense near equilibrium and blackbody sources, such as the gas core reactor, and electric discharge plasma devices, which are the key to the development of intense broadband radiation sources. The possible use of radiation from solar concentrators in space also fits into this general area. The varied use of photoexcitation of lasers are discussed ranging over direct optical pumping, photodissociation, and photoreionization. In addition, the new uses of laser transitions and chemical reactions is shown. This is accomplished through multiline operation of high pressure tunable lasers which can use the broadband radiation for multiphoton excitation. G.Y.

N78-26865*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
STATUS OF PHOTOELECTROCHEMICAL PRODUCTION OF HYDROGEN AND ELECTRICAL ENERGY c44
Charles E. Byvik and Gilbert H. Walker *In* Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 244-247 refs (For availability see N78-26837 17-70)
Avail: NTIS HC A13/MF A01 CSCL 10A

The efficiency for conversion of electromagnetic energy to chemical and electrical energy utilizing semiconductor single crystals as photoanodes in electrochemical cells was investigated. Efficiencies as high as 20 percent were achieved for the conversion of 330 nm radiation to chemical energy in the form of hydrogen by the photoelectrolysis of water in a SrTiO3 based cell. The SrTiO3 photoanodes were shown to be stable in 9.5 M NaOH solutions for periods up to 48 hours. Efficiencies of 9 percent were measured for the conversion of broadband visible radiation to hydrogen using n-type GaAs crystals as photoanodes. Crystals of GaAs coated with 500 nm of gold, silver, or tin for surface passivation show no significant change in efficiency. By suppressing the production of hydrogen in a CdSe-based photogalvanic cell, an efficiency of 9 percent was obtained in conversion of 633 nm light to electrical energy. A CdS-based photogalvanic cell produced a conversion efficiency of 5 percent for 500 nm radiation. Author

N78-26866*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
UF6 BREEDER REACTOR POWER PLANTS FOR ELECTRIC POWER GENERATION c73
J. H. Rust (Ga. Inst. of Tech., Atlanta), J. D. Clement (Ga. Inst. of Tech., Atlanta), and F. Hohl *In* Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 248-254 refs (For availability see N78-26837 17-70)
(Grants NsG-7068; NsG-1168)
Avail: NTIS HC A13/MF A01 CSCL 18L

The reactor concept analyzed is a U-233F6 core surrounded by a molten salt (Li(7)F, BeF2, ThF4) blanket. Nuclear survey calculations were carried out for both spherical and cylindrical geometries. Thermodynamic cycle calculations were performed for a variety of Rankine cycles. A conceptual design is presented along with a system layout for a 1000 MW stationary power plant. Advantages of the gas core breeder reactor (GCBR) are as follows: (1) high efficiency; (2) simplified on-line reprocessing; (3) inherent safety considerations; (4) high breeding ratio; (5) possibility of burning all or most of the long-lived nuclear waste actinides; and (6) possibility of extrapolating the technology to higher temperatures and MHD direct conversion. Author

N78-26867*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
GEORGIA INSTITUTE OF TECHNOLOGY RESEARCH ON THE GAS CORE ACTINIDE TRANSMUTATION REACTOR (GCATR) c73
J. D. Clement, J. H. Rust, A. Schneider, and F. Hohl *In* Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 255-262 refs Prepared in cooperation with Ga. Inst. of Tech., Atlanta (For availability see N78-26837 17-70)
Avail: NTIS HC A13/MF A01 CSCL 18K

The program reviewed is a study of the feasibility, design, and optimization of the GCATR. The program is designed to take advantage of initial results and to continue work carried out on the Gas Core Breeder Reactor. The program complements NASA's program of developing UF6 fueled cavity reactors for power, nuclear pumped lasers, and other advanced technology applications. The program comprises: (1) General Studies--Parametric survey calculations performed to examine the effects of reactor spectrum and flux level on the actinide transmutation for GCATR conditions. The sensitivity of the results to neutron cross sections are to be assessed. Specifically, the parametric calculations of the actinide transmutation are to include the mass, isotope composition, fission and capture rates, reactivity effects, and neutron activity of recycled actinides. (2) GCATR Design Studies--This task is a major thrust of the proposed research program. Several subtasks are considered: optimization criteria studies of the blanket and fuel reprocessing, the actinide insertion and recirculation system, and the system integration. A brief review of the background of the GCATR and ongoing research is presented. G.Y.

N78-26868*# Florida Univ., Gainesville.
APPLICATION OF GASEOUS CORE REACTORS FOR TRANSMUTATION OF NUCLEAR WASTE c73
B. G. Schnitzler, R. R. Paternoster, and R. T. Schneider *In* Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 263-268 refs (For availability see N78-26837 17-70)
Avail: NTIS HC A13/MF A01 CSCL 18G

An acceptable management scheme for high-level radioactive waste is vital to the nuclear industry. The hazard potential of the trans-uranic actinides and of key fission products is high due to their nuclear activity and/or chemical toxicity. Of particular concern are the very long-lived nuclides whose hazard potential remains high for hundreds of thousands of years. Neutron induced transmutation offers a promising technique for the treatment of problem wastes. Transmutation is unique as a waste management

scheme in that it offers the potential for 'destruction' of the hazardous nuclides by conversion to non-hazardous or more manageable nuclides. The transmutation potential of a thermal spectrum uranium hexafluoride fueled cavity reactor was examined. Initial studies focused on a heavy water moderated cavity reactor fueled with 5% enriched U-235-F6 and operating with an average thermal flux of 6 times 10 to the 14th power neutrons/sq cm-sec. The isotopes considered for transmutation were I-129, Am-241, Am-242m, Am-243, Cm-243, Cm-244, Cm-245, and Cm-246. Author

N78-26869*# Illinois Inst. of Tech., Chicago.
GAS CORE REACTORS FOR COAL GASIFICATION c44
Herbert Weinstein *In* Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 269-274 refs (For availability see N78-26837 17-70)
(Grant NsG-7039)
Avail: NTIS HC A13/MF A01 CSCL 10A

The concept of using a gas core reactor to produce hydrogen directly from coal and water is presented. It is shown that the chemical equilibrium of the process is strongly in favor of the production of H2 and CO in the reactor cavity, indicating a 98% conversion of water and coal at only 1500 K. At lower temperatures in the moderator-reflector cooling channels the equilibrium strongly favors the conversion of CO and additional H2O to CO2 and H2. Furthermore, it is shown the H2 obtained per pound of carbon has 23% greater heating value than the carbon so that some nuclear energy is also fixed. Finally, a gas core reactor plant floating in the ocean is conceptualized which produces H2, fresh water and sea salts from coal. Author

N78-26870*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CONSIDERATIONS TO ACHIEVE DIRECTIONALITY FOR GAMMA RAY LASERS c36
S. Jha (Cincinnati Univ.) and J. Blue *In* Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 275-279 refs (For availability see N78-26837 17-70)
(Grant NsG-3091)
Avail: NTIS HC A13/MF A01 CSCL 20E

A method of alignment of nuclei for a gamma ray laser and a means of achieving preferential emission of radiation along the crystal axis are studied. Atomic alignment was achieved by materials researchers who made composite structures composed of needle-like single crystals all with the same orientation and all pointing in the same direction contained in a matrix of cobalt or nickel. The proposed method of preferential emission of radiation along the aligned needles is to have a symmetric field gradient at the nucleus and a sequence of excited levels of spin and parity 2(+) and 0(+). The proposed scheme reduces the density of excited states required for lasing and reduces the linewidth due to inhomogenous broadening. Mossbauer absorption experiments intended to test these ideas are outlined. Author

N78-26871# Chalmers Univ. of Technology, Goteborg (Sweden). Inst. of Theoretical Physics.
SCATTERING FROM BURIED INHOMOGENEITIES - A GENERAL THREE-DIMENSIONAL FORMALISM
Gerhard Kristensson and Staffan Stroem Sep. 1977 76 p refs Sponsored by the Swed. Inst. of Appl. Math.
(CTH-ITP-77-32) Avail: NTIS HC A05/MF A01

A general three-dimensional formalism for scattering in two half-spaces is given in which one of the half spaces contains a bounded inhomogeneity. The formalism consists of an extension of the transition matrix method, given by Waterman, which applies equally well to acoustic, electromagnetic, and elastic scattering and is developed in detail for the case when the source and inhomogeneity are situated in different half-spaces. The basic equations are given also for the case when the source and the inhomogeneity lie in the same half-space. In the final expression for the total scattered field, that part, which depends on the presence of the inhomogeneity, can be separated and the physical meaning of the various quantities which determine this anomalous scattered field, are identified. Previous results on various bounded configurations of scatterers are inserted in the present formalism. Numerical results are given for inhomogeneities consisting of one or two spheres. Author (ESA)

N78-26872# Chalmers Univ. of Technology, Goteborg (Sweden). Inst. for Electromagnetic Field Theory and Plasma Physics.
EVOLUTION IN SPACE AND TIME OF TWO INTERACTING INTENSITIES Research and Training Programme on Controlled Thermonuclear Fusion and Plasma Physics (EUR-NE)
Hans Wilhelmsson 1977 18 p refs
(CTH-IEFT/PP-1977-1) Avail: NTIS HC A02/MF A01

The basic nonlinear coupled equations describing the interaction between two intensities (or two populations) are discussed. Analytic solutions are deduced for the evolution in space and time of initially given perturbations of the equilibrium intensities. Author (ESA)

71 ACOUSTICS

Includes sound generation, transmission and attenuation.

For noise pollution see *45 Environment Pollution*.

N78-26873 Brown Univ., Providence, R. I.
STUDIES OF THE ULTRASONIC ATTENUATION ANISOTROPY AND OF ULTRASONIC SECOND HARMONICS IN A NEMATIC LIQUID CRYSTAL Ph.D. Thesis
Carlos Agustin Castro Mendoza 1977 166 p
Avail: Univ. Microfilms Order No. 78-09040

The results of some ultrasonic measurements in the nematic liquid crystal n-(p-methoxy-benzylidene)-p-butylaniline (MBBA) are reported. Measurements were made of the temperature and frequency dependence of the anisotropy in the ultrasonic attenuation coefficient Delta alpha, of the relative attenuation coefficient alpha near the nematic to isotropic transition temperature T sub c, and of the amplitude xi sub 2 of the ultrasonic second harmonic generated in the liquid crystal. The ultrasonic attenuation anisotropy Delta alpha is analyzed in terms of two relaxation processes, one critical and one noncritical, and a nonrelaxing part. A microscopic mechanism is proposed which accounts for most features of the anisotropy of the noncritical component of Delta alpha. Measurements of the ultrasonic second harmonic amplitude xi sub 2 are related to changes in the nonlinear coupling coefficient zeta with temperature. Dissert. Abstr.

N78-26874 Cornell Univ., Ithaca, N. Y.
DIFFRACTION OF SOUND PULSES AND ACOUSTIC EMISSION IN A HOLLOW ELASTIC CYLINDER Ph.D. Thesis
Pocheng Chen 1978 182 p
Avail: Univ. Microfilms Order No. 78-09463

The propagation of sound pulses in a thick-walled circular cylinder was analyzed by integral transformation. The transient waves were generated by a line source parallel to the axis of the cylinder, and were reflected and diffracted by both cylindrical surfaces. The multiple reflected pulses are represented by generalized ray integrals, each of which represents a pulse traveling along a specific ray path, and the inverse transforms of these ray integrals are evaluated by a modified Cagniard method. The analysis predicts the arrival times, magnitudes, and time history of the diffracted pulses. The total wave motion is sorted into waves traveling along the paths of incident ray, reflected rays, creeping rays, chord rays, head wave rays, and slip-stream rays. Numerical examples demonstrate the diffraction of sound pulse by a cylindrical cavity in solids, and the multiple reflections of a pulse by two cylindrical surfaces. Dissert. Abstr.

N78-26875 British Broadcasting Corp., Kingswood (England). Engineering Div.
AN EXPERIMENTAL 4-PHASE DPSK STEREO SOUND SYSTEM: THE EFFECT OF MULTIPATH PROPAGATION
M. J. Kallaway May 1978 15 p refs
(BBC-RD-1978/15) Avail: BBC, Kingswood Warren, Tadworth, Surrey, England

The effects of multipath propagation (echoes) on an experimental 4 phase d.p.s.k. stereo sound system were studied. The system has applications in outside broadcast radio links and could be used in satellite broadcasting. For an echo to reception

significantly when signal-strength are low, its relative amplitude must be at least 15 percent. The effect of an echo is largely independent of its delay. The results of the tests were used to calculate the effect of co-channel interference. A.R.H.

N78-26876*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
CONCORDE NOISE-INDUCED BUILDING VIBRATIONS: JOHN F. KENNEDY INTERNATIONAL AIRPORT
W. H. Mayes, D. G. Stephens, R. DeLoach, J. M. Cawthorn, H. K. Holmes, R. B. Lewis, B. G. Holliday, D. W. Ward, and W. T. Miller Apr. 1978 47 p refs
(NASA-TM-78727; Rept-3) Avail: NTIS HC A03/MF A01 CSCL 20A

Outdoor and indoor noise levels resulting from aircraft flyovers and certain nonaircraft events were recorded at eight homesites and a school along with the associated vibration levels in the walls, windows, and floors at these test sites. Limited subjective tests were conducted to examine the human detection and annoyance thresholds for building vibration and rattle caused by aircraft noise. Both vibration and rattle were detected subjectively in several houses for some operations of both the Concorde and subsonic aircraft. Seated subjects more readily detected floor vibrations than wall or window vibrations. Aircraft noise generally caused more window vibrations than common nonaircraft events such as walking and closing doors. Nonaircraft events and aircraft flyovers resulted in comparable wall vibration levels, while floor vibrations were generally greater for nonaircraft events than for aircraft flyovers. The relationship between structural vibration and aircraft noise is linear, with vibration levels being accurately predicted from overall sound pressure levels (OASPL) measured near the structure. Relatively high levels of structural vibration measured during Concorde operations are due more to higher OASPL levels than to unique Concorde-source characteristics.
Author

N78-26877*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A RING-SOURCE MODEL FOR JET NOISE
Lucio Maestrello Apr. 1978 41 p refs Presented at the 95th Meeting of the Acoust. Soc. of Am., Providence, 14-19 May 1978
(NASA-TM-73959) Avail: NTIS HC A03/MF A01 CSCL 20A

A model consisting of two ring sources was developed to study the direct radiation of jet noise in terms of correlation, coherence, and phase and also to aid in solving the inverse radiation problem of determining the noise source in terms of far-field measurements. The rings consist of discrete sources which are either monopoles or quadrupoles with Gaussian profiles. Only adjacent sources, both within the rings and between rings, are correlated. Results show that from the far-field information can be used to determine when the sources are compact or noncompact with respect to the acoustic wavelength and to distinguish between the types of sources. In addition, from the inverse radiation approach, the center of mass, the location and separation distance of the ring, and the diameters can be recovered. A.R.H.

N78-26878*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
VARIATION OF FAN TONE STEADINESS FOR SEVERAL INFLOW CONDITIONS
J. R. Balombin Jul. 1978 19 p refs Presented at the 11th Fluid and Dyn. Conf., Seattle, 10-12 Jul. 1978; sponsored by AIAA
(NASA-TM-78886; E-9621; AIAA-Paper-78-1119) Avail: NTIS HC A02/MF A01 CSCL 20A

An amplitude probability density function analysis technique for quantifying the degree of fan noise tone steadiness has been applied to data from a fan tested under a variety of inflow conditions. The test conditions included typical static operation, inflow control by a honeycomb/screen device and forward velocity in a wind tunnel simulating flight. The ratio of mean square sinusoids to-random signal content in the fundamental and second harmonic tones was found to vary by more than an order-of-magnitude. Some implications of these results concerning the nature of fan noise generation mechanisms are discussed.
Author

N78-26879*# Georgia Inst. of Tech., Atlanta. School of Mechanical Engineering.
AIRCRAFT NOISE PROPAGATION Final Technical Report
W. James Hadden and Allan D. Pierce Jun. 1978 128 p refs
(Grant NsG-1307)
Avail: NTIS HC A07/MF A01 CSCL 20A

Sound diffraction experiments conducted at NASA Langley Research Center to study the acoustical implications of the engine over wing configuration (noise-shielding by wing) and to provide a data base for assessing various theoretical approaches to the problem of aircraft noise reduction are described. Topics explored include the theory of sound diffraction around screens and wedges; the scattering of spherical waves by rectangular patches; plane wave diffraction by a wedge with finite impedence; and the effects of ambient flow and distribution sources. A.R.H.

N78-26880*# Lockheed-Georgia Co., Marietta.
NOISE CHARACTERISTICS OF UPPER SURFACE BLOWN CONFIGURATIONS: SUMMARY Final Report, May 1975 - Nov. 1976
N. N. Reddy and J. S. Gibson Jun. 1978 60 p refs
(Contract NAS1-13870)
(NASA-CR-2918; LG77ER0103) Avail: NTIS HC A04/MF A01 CSCL 20A

A systematic experimental program was conducted to develop a data base for the noise and related flow characteristics of upper surface blown configurations. The effect of various geometric and flow parameters was investigated experimentally. The dominant noise was identified from the measured flow and noise characteristics to be generated downstream of the trailing edge. The possibilities of noise reduction techniques were explored. An upper surface blown (USB) noise prediction program was developed to calculate noise levels at any point and noise contours (footprints). Using this noise prediction program and a cruise performance data base, aircraft design studies were conducted to integrate low noise and good performance characteristics. A theory was developed for the noise from the highly sheared layer of a trailing edge wake. Theoretical results compare favorably with the measured noise of the USB model.
Author

N78-26881*# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
A REVIEW OF THE THEORY OF TRAILING EDGE NOISE Contractor Report, Jul. - Dec. 1977
M. S. Howe Jun. 1978 67 p refs
(Contract NAS1-14611)
(NASA-CR-3021; BBN-3679) Avail: NTIS HC A04/MF A01 CSCL 20A

Literature on the theory of the generation of sound by the interaction of low Mach number turbulent flow with the edge of a semi-infinite rigid plate is critically reviewed. Three different approaches to the subject are identified, consisting of theories based on (1) Lighthill's acoustic analogy; (2) the solution of special, linearized hydroacoustic problems; and (3) ad hoc aerodynamic source models. When appropriately interpreted, all relevant theories produce essentially identical predictions in the limit of very small Mach numbers. None of the theories discusses the implications of the Kutta condition, however, nor of the effect of forward flight and source motion relative to the trailing edge. An outline of a redevelopment of the theory is included to give a unified view of the problem, exhibit the significance of the various approximations, and incorporate the effect of mean motion and of the Kutta condition. A.R.H.

N78-26882# Chalmers Univ. of Technology, Goteborg (Sweden). Inst. of Theoretical Physics.
A METHOD FOR CALCULATING THE SOUND ATTENUATION IN A SILENCER, CONSISTING OF FINITE SECTIONS OF BULK REACTING LINING IN A CYLINDRICAL DUCT WITH MEAN FLOW
Olle Brander and Boerje Nilsson 30 Sep 1977 88 p refs
(CTH-ITP-TMF-77-1) Avail: NTIS HC A05/MF A01

A general method is presented for taking into account the reflection, transmission, and propagation of all relevant modes in a silencer, consisting of finite sections of bulk-reacting lining in a cylindrical duct with gas flow. The general problem is thus

reduced to the study of two standard problems. The first is the well known, but not yet completely worked, throw problem of an infinite duct with bulk-reacting lining and flow. Some numerical results are presented which stress the importance of an often overlooked phenomenon in this connection - the so called amplifying modes. The second problem concerns the reflection and transmission properties of a junction between two different sections of the duct. This problem is solved with integral equation methods from the theory of electromagnetic wave guides.
Author (ESA)

N78-26883# Physics Lab. RVO-TNO, The Hague (Netherlands).
RESULTS OF THE ACOUSTIC EXPERIMENT ON SEA SURFACE REFLECTION, CARRIED OUT AT AFAR ON 9TH JUNE 1973
J. G. Schothorst Mar. 1977 53 p refs
(PhL-1977-11; TDCK-69020) Avail: NTIS HC A04/MF A01

In June 1973, the Netherlands carried out a series of surface reflection measurements at AFAR (Azores Fixed Acoustic Range) with the assistance of the British ship R.M.A.S. St. Margarets. These measurements were taken to study the characteristics of surface reflected signals, like fluctuation, time spread, and loss, for practical sonar conditions. The measurements were carried out under calm weather conditions. During the one day experiment a large quantity of reliable data was recorded. The experiment, analysis, and results obtained are described.
Author (ESA)

N78-26884# Physics Lab. RVO-TNO, The Hague (Netherlands).
SOME REMARKS CONCERNING THE OCCURRENCE OF A DIRECT ACOUSTIC PATH BETWEEN THE AFAR TOWERS ECHO-NOVEMBER AND ECHO-SIERRA
J. G. Schothorst and A. M. G. H. Saanen Apr. 1977 23 p refs
(Contract A72/KM/137)
(PhL-1977-15; TDCK-69187) Avail: NTIS HC A02/MF A01

In June 1973, the Netherlands carried out a series of measurements on sea surface reflection at the Azores Fixed Acoustic Range (AFAR) between the ECHO tower and a measuring ship. From the analysis of these acoustic measurements, some information was also obtained on the fluctuation of signals traveling along a direct path (path without reflections). The fluctuation of the direct path signals appeared to be less than what would be expected on the basis of measurements between the AFAR towers. Because of this, it was discussed whether indeed corresponding data could be obtained from measurements between the AFAR towers. In order to investigate this aspect a number of ray tracings have since been made for the two sound velocity profiles which were taken on June 9, 1973, the one day during which the surface reflection measurements were carried out. Since the recorded sound velocity profiles extended only to a depth of 600 m, values for the sound velocity for greater depths were added using reported mean monthly profiles. The results obtained from this brief investigation are described.
Author (ESA)

N78-26885# Physics Lab. RVO-TNO, The Hague (Netherlands).
UNDERWATER ACOUSTIC PROPERTIES OF CORK-RUBBER
H. A. J. Rijnja Apr. 1977 45 p refs
(Contract A68/KM/108)
(PhL-1977-16; TDCK-69188) Avail: NTIS HC A03/MF A01

The ability of cork-rubber compounds to absorb sound under water is well known, but generally this property varies strongly with hydrostatic pressure. A large number of different compositions was investigated, leading to the discovery of materials superior to others as a sound absorbing material in electroacoustic transducers for deep submergence. Author (ESA)

N78-26886# Technische Physische Dienst TNO-TH, Delft (Netherlands). Afd. Geluid.
SOME METHODS TO IMPROVE THE SIGNAL-NOISE RATIO FOR THE ANALYSIS OF ACOUSTIC SIGNALS [ENIGE METHODEN VOOR HET VERBETEREN VAN DE SIGNAAL-STOORVERHOUDING BIJ DE ANALYSE VAN AKOESTISCHE SIGNALEN]
K. Verhulst 7 Jul. 1977 29 p refs In DUTCH; ENGLISH summary
(Contract A76/KM/035)
(TPD-708.122; TDCK-69659) Avail: NTIS HC A03/MF A01

Low signal-noise ratio problems encountered especially during acoustic measurements onboard navy ships are discussed. Extraneous noise often causes difficulties when acoustical measurements are being taken. Depending on the available signal, special methods can improve the signal to noise ratio. In particular, the use of a digital analyzing system makes mode advanced techniques available. One of these special methods is the correlation technique, which can be used, for example, to suppress background noise. In certain cases it is sufficient to do a narrow band analysis. On a digital analyzing system it is possible to carry out further manipulations on such narrow band results. In addition, another technique to exceed the background noise level is the application of explosions as a source. For the analysis of these short signals more detailed instructions are given.
Author (ESA)

N78-26887# Bureau of Radiological Health, Rockville, Md.
SYMPOSIUM ON BIOLOGICAL EFFECTS AND CHARACTERIZATIONS OF ULTRASOUND SOURCES Final Report
DeWitt G. Hazzard and Madeleine Litz, ed. Dec. 1977 260 p refs Conf. held at Rockville, Md., 2-3 Jun. 1977
(PB-277945/2; FDA/BRH-78/49; DHEW/PUB/FDA-78/8048)
Avail: NTIS HC A12/MF A01 CSCL 06R

Presentations and subsequent discussions cover subject areas such as the effects of fetal exposure to ultrasound; the effects of ultrasound on human and animal biological systems; ultrasound measurement instrumentation and techniques; and compliance activities relating to the performance standard for therapeutic ultrasound equipment. GRA

72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure and molecular spectra.

N78-26888 Brandeis Univ., Waltham, Mass.
COMPARISON OF EXPERIMENTAL AND THEORETICAL COMPTON PROFILES: EFFECTS OF MOLECULAR VIBRATION AND MULTIPLE SCATTERING Ph.D. Thesis
Elaine Braun 1977 155 p
Avail: Univ. Microfilms Order No. 78-08626

The effect of molecular vibration on the Compton profile of H2 is examined using a variety of nuclear and electronic wavefunctions. The effect is found to be small, but depends strongly on the wavefunction type. Anomalous results are found with a very simple wavefunction. A method of correcting Compton profiles for multiple scattering is derived. The relationship between the single and experimental Compton profiles is stated as an operator equation. This operator equation may be solved by a generalized Newton's method, giving an iterative method to correct experimental Compton profiles. The convergence properties of this method are demonstrated. Upper and lower bounds on the errors associated with multiple scattering corrections are derived. Dissert. Abstr.

N78-26889 Nebraska Univ., Lincoln.
DIFFERENTIAL ELECTRON SCATTERING MEASUREMENTS IN HELIUM FOR SLOW ELECTRONS Ph.D. Thesis
Victor Cyril Sutcliffe, Jr. 1977 143 p
Avail: Univ. Microfilms Order No. 7808175

Electron impact cross sections, differential in angle, were measured for electron-helium collisions for selected energies below 100eV. Normalized elastic cross sections and normalized excitation cross sections for the n=2 states of helium were measured for 50 and 80eV. An angular study of the energy dependent structure of the elastic cross section in the neighborhood of the n=2 threshold was performed and the broad p-wave resonance was observed at 21.2eV. The excitation function of the 2 1P state was measured. Dissert. Abstr.

N78-26890 Pennsylvania State Univ., University Park.
ANALYSIS OF THE ELASTIC SCATTERING OF NEGATIVE MUONS FROM ATOMIC HYDROGEN Ph.D. Thesis

Rafael Juan Muller 1977 90 p
Avail: Univ. Microfilms Order No. 7808398

The total elastic cross section and the transport cross section for the scattering of negative muons from the hydrogen atom is determined by making a partial wave analysis of the elastic scattering amplitude. An effective Schrodinger equation for the muon-hydrogen system is obtained, using a static model of the field of the hydrogen atom, and its numerical solution allows us to obtain the phase shifts for fifty partial waves, over a wide range of energies. A polarization potential term is then included, and the results of the scattering from the effective potential obtained are compared with the results from the static field. The results show a substantial effect of the polarization in the cross sections at low energy. The analysis of the low energy behavior of the phase shifts indicates that a substantial number of bound states for the muon exist in both the static and the static + polarization fields of hydrogen. Dissert. Abstr.

N78-26891 Stanford Univ., Calif.
ENERGY STORAGE AND TWO PHOTON EXTRACTION FROM METASTABLE STATES Ph.D. Thesis
Hiroshi Komine 1978 163 p
Avail: Univ. Microfilms Order No. 78-08808

Experimental studies on the energy storage characteristics of excited metastable species and theoretical analysis of optical energy extraction schemes based on stimulated two photon transitions are discussed. The feasibility of two photon amplifier is discussed with two proposed systems in atomic mercury and atomic iodine. The semi-empirical methods of gain calculation are described for the near-resonance case and the non-resonant case. The use ,of spherical tensor operator algebra and the evaluation of electric dipole matrix elements in the intermediate angular momentum coupling scheme are discussed. The experimental requirements for the proposed systems based on the calculated gains indicate that the currently available pumping methods and trigger laser sources may lead to a demonstration of two photon amplification and energy extraction.
Dissert. Abstr.

N78-26892 North Texas State Univ., Denton.
TARGET THICKNESS DEPENDENCE OF Cu K X-RAY PRODUCTION FOR IONS MOVING IN THIN SOLID Cu TARGETS Ph.D. Thesis
Raymond Keith Gardner, Jr. 1977 92 p
Avail: Univ. Microfilms Order No. 7807831

Measurements of the target thickness dependence of the target X-ray production yield for incident fast heavy ions are reported for thin solid Cu targets as a function of both incident projectile atomic number and energy. The incident ions were F, Al, Si, S, and Cl. The target thicknesses ranged from 2 to 183 micron g/sq cm. In each case the Cu K X-ray yield exhibits a complex exponential dependence on target thickness. A two-component model which includes contributions to the target X-ray production due to ions with 0 and 1 K vacancies and a three-component model which includes contributions due to ions with 0, 1, and 2 K vacancies were developed to describe the observed target K X-ray yields. Dissert. Abstr.

N78-26893 State Univ. of New York, Albany.
HIGH RESOLUTION STUDY OF X-RAYS EMITTED FROM GAS TARGETS IN NEAR SYMMETRIC COLLISIONS (Z APPROXIMATELY 8) Ph.D. Thesis
Vincent A. Dutkiewicz 1977 157 p
Avail: Univ. Microfilms Order No. 78-09144

Oxygen and neon relative K X-ray cross sections and fractional line intensities are reported for symmetric and near-symmetric collisions with gas targets at E = 0.2 MeV/ amu: a curve crystal X-ray spectrometer, in addition to a gas flow proportional counter, was used to record the emitted X-rays. The composition of resolved lines in the O and Ne high resolution K X-ray spectra is deduced and a procedure to apply fluorescence yields to these X-rays spectra is presented which allows both L-vacancy distribution and the total K fluorescence yield to be extracted. Differences in O K X-rays emitted from a thick Al2O3 and a O2 gas, as well as for CO and H2O gas targets are observed and discussed. Several counting schemes to determine the number of 2p ps sub x vacancies are compared to O K vacancy cross section in 0.2 MeV /amu O(q+) -Ne and N(q+)-O collisions and the merits of each counting scheme is discussed.
Dissert. Abstr.

N78-26894 Cornell Univ., Ithaca, N. Y.
THEORETICAL INVESTIGATIONS OF A H(+)-Cs CHARGE EXCHANGE LASER AND PHOTON-ASSISTED NONRESONANT CHARGE EXCHANGE REACTIONS Ph.D. Thesis
Drew Arlen Copeland 1977 269 p
Avail: Univ. Microfilms Order No. 7807745

A vacuum ultraviolet lasing scheme employing charge exchange between an ion and Cs atoms is described and the dominant reaction processes of a hydrogen plasma and a cesium target are enumerated and discussed. Photon-assistance of nonresonant hydrogen-ion alkali-atom charge exchange reactions via application of intense optical radiation during their collisional encounter were explored. A simple two-state molecular theory for calculating the cross section of the photon-assisted nonresonant charge exchange process A(+) + B + h omega yields B(+) was developed and applied. Dissert. Abstr.

N78-26895 Pennsylvania State Univ., University Park.
DIRECT OBSERVATIONS OF ATOMIC INTERACTIONS USING THE FIELD ION MICROSCOPE Ph.D. Thesis
Paul Lloyd Cowan 1977 194 p
Avail: Univ. Microfilms Order No. 7808342

Field microscope (FIM) observations of the surface diffusion of single adatoms and small adatom clusters were used to obtain information concerning interactions at the atomic level. Three types of interactions were studied, adatom-substrate interactions, adatom-adatom interactions and adatomsubstitutional atom interactions. In studying these interactions, new methods of analyzing FIM observations were developed. The displacement distribution functions for various types of random and restricted walks were obtained for the first time. In most cases these functions were obtained analytically from the jump length distribution. The case of a two-dimensional walk with a boundary was solved by Monte Carlo methods. These theoretical displacement distribution functions were fit by the method of least squares to experimental displacement distribution functions to obtain various adatom-substrate interaction parameters. Dissert. Abstr.

N78-26896# Brookhaven National Lab., Upton, N. Y.
NEW STATES BELOW 2.2 GeV OBSERVED IN e+e ANNIHILATIONS
S. D. Protopopescu 1977 24 p refs
(Contract EY-76-02-0016)
(BNL-23612; Conf-771089-4) Avail: NTIS HC A02/MF A01

Data obtained at the new e(+)e(-) storage rings DCI at Orsay, and at the ALDONE facility at Frascati indicate a rich spectroscopy of 1(-) states between 1.35 and 2.2 GeV. Evidence exists for as many as seven resonance states in the 2.2 GeV energy region. DCI reports two relatively narrow I-O states, one near 1660 MeV with approximately 25 MeV and the other near 1770 MeV with approximately 50 MeV; as well as two possible broad I1 states at 1540 and 1700 MeV, both close to 200 MeV wide. From ALDONE comes evidence for three narrow states; at 2130 MeV with less than 50 MeV, at 1830 MeV with approximately or less than 30 MeV, and at 1489 with approximately or less than 4 MeV. Of all the states claimed by DCI and ALDONE, evidence is strongest for the ones at 1830 MeV and 1498 MeV. ERA

N78-26897# Brookhaven National Lab., Upton, N. Y. Physics Dept.
NEUTRINO PRODUCTION OF NEW PARTICLES IN BUBBLE CHAMBERS
N. P. Samios 1977 16 p Presented at the SLAC Summer Inst. on Particle Phys., Stanford, Calif., 20-27 Jul. 1977
(Contract EY-76-C-02-0016)
(BNL-23676; Conf-770751-3) Avail: NTIS HC A02/MF A01

Some results from the study of neutrino interactions above 1 GeV are summarized which are relevant to the utility of such investigation for unearthing new phenomena. The variety of experimental searches and their relevance, bubble chamber techniques, review of the Glashow-Iliopoulos-Maiani model predictions for leptonic decay, and some experimental results for charmed and strange particle phenomena, di-lepton results,

nonleptonic decay of charm, evidence for D deg production, and heavy leptons are discussed. ERA

N78-26898# Princeton Univ., N. J. Dept. of Physics.
CHARGE CONJUGATION SYMMETRY IN PROTON-ANTIPROTON INTERACTIONS AT 5.4 GeV ENERGY Ph.D. Thesis
J. D. Whittaker Oct. 1977 141 p
(Contract EY-76-C-02-3072)
(COO-3072-91) Avail: NTIS HC A07/MF A01

The measurement was made with a double arm spectrometer, with each arm triggered independently. Each spectrometer arm had an acceptance of 15 millisteradians and subtended an angular range of 16 to 20 degrees in the lab, 77 to 91 degrees in the pion center of mass system (CMS). Corrections were made for target empty, for pions in the incident beam, and for particle misidentification in the spectrometer. The resulting symmetry was .0084 + or - .0090; consistent with zero. The asymmetry introduced by differential pion absorption in the spectrometer was estimated to be .0021. ERA

N78-26269# General Motors Research Labs., Warren, Mich.
FORMULAE FOR THE THERMODYNAMIC PROPERTIES OF NORMAL MOLECULAR HYDROGEN
W. J. Gordon and R. Hickling *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 2: Stirling Cycle Anal. and Eng. Design Studies Apr. 1978 16 p refs (For availability see N78-26262 17-31)
(GMR-2690-Sect-2.107) Avail: NTIS HC A14/MF A01

N78-26853*# United Technologies Research Center, East Hartford, Conn.
THE EMISSION CHARACTERISTICS OF URANIUM HEXAFLUORIDE AT HIGH TEMPERATURES
N. L. Krascella *In* Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 146-155 refs (For availability see N78-26837 17-70)
(Contract NAS1-13291)
Avail: NTIS HC A13/MF A01 CSCL 20H

73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory.

For space radiation see *93 Space Radiation.*

N78-26899 Princeton Univ., N. J.
INTERACTION OF LEPTONS AND MAGNETIC MONOPOLES Ph.D. Thesis
Mehrdad Moshir 1977 126 p
Avail: Univ. Microfilms Order No. 78-07458

The interaction of solitons with other particles represented by extra field variables was studied by solving a Schrodinger equation for the auxiliary fields in a potential generated by the soliton solution with emphasis on the case where the soliton is the 't Hooft-Polyakov magnetic monopole. A multiplet of charged scalar fields was used for the auxiliary fields, and the case of a multiplet of spin 1/2 fields was considered. The Georgi-Glashow model for leptons was used and the cross section for the neutrino turning into an electron and the monopole turning into a dyon was calculated. A mass of 50 Gev. for the W mesons was assumed in evaluating the cross sections for the scalar and Georgi-Glashow cases numerically. In the energy range of order 1 Gev, the cross section for the process (neutrino-electron) is some orders of magnitude larger than the neutrino-nucleon total cross section, and at an energy of 10 Gev. the ratio reaches 10,000. Dissert. Abstr.

N78-26900 Colorado Univ., Boulder.
A MEASUREMENT OF THE FORWARD DIFFERENTIAL CROSS SECTION FOR THE REACTION np YIELDS pp PION(-) IN THE MOMENTUM RANGE 4 TO 12 GeV/c Ph.D. Thesis
David James McQuate 1977 268 p
Avail: Univ. Microfilms Order No. 7808918

The experiment used the SLAC K circle sub L spectrometer and the fifteen inch rapid cycling bubble chamber. In eight hundred thousand pictures, 5946 events were found in the momentum range 4 to 15 GeV/c, the (p pi(-)) combined mass range 1.08 to 1.9 GeV/sq c, and in the momentum transfer range 0.006 to 0.4 (GeV/c) squared. The cross section obtained is nearly constant at about .08 millibars for momenta above 6 GeV/c. The different cross section obtained shows a dip at -t = 0.22 (GeV/c) squared for masses between 1.0 and 1.3 GeV/sq c; the dip is stationary for changes in incident neutron momentum. The momentum transfer distributions fall exponentially and exhibit dual slop exponential dependence for masses below 1.4 GeV/sq c. The mass distribution shows a strong peak at 1.69 GeV/sq c which contains relatively more events as the momentum transfer increases, but fewer as the incident momentum increases. A broad enhancement in the mass distribution is observed in the mass range 1.1. to 1.5 GeV/sq c. Dissert. Abstr.

N78-26901 City Univ. of New York.
DUAL RESONANCE MODELS AND THEIR CURRENTS Ph.D. Thesis
Edward A. Johnson 1978 116 p
Avail: Univ. Microfilms Order No. 7808687

Dual resonance models were rederived from the concept of a string tracing out a surface in space-time. Thus, interacting strings reproduced the dual amplitudes which describe interactions between hadrons and currents (for example, electrons), as well as interactions involving only hadrons. A new dual current is constructed that is manifestly factorizable and appears to be valid for arbitrary space-time dimension. The fact that this current is not bound at d=26 leads to interesting speculations on the nature of dual currents. Dissert. Abstr.

N78-26902 California Univ., Davis.
INCLUSIVE PION(+)p AND pp PROCESSES AT 100 GeV/c Ph.D. Thesis
William Joseph Erwin 1977 177 p
Avail: Univ. Microfilms Order No. 7809224

The inclusive processes of charged particles produced in pion(+) p and pp interactions at 100 GeV/c are presented. The values obtained for integrated cross sections (total, 2 prong elastic and inelastic and charged prongs) are given. Inclusive distributions for pion(+) and pion(-) are analyzed in the light of predictions made by the Mueller-Regge model. Inclusive distributions in recoil mass squared and momentum transfer squared are given for identified protons. Correlations between pion(+) and pion(-) pairs as well as between pion(-) and pion(-) pairs are shown and discussed. Dissert. Abstr.

N78-26903 Texas Univ., Austin.
UNITARITY, RENORMALIZATION, AND APPLICATIONS OF A NON-ABELIAN GAUGE THEORY Ph.D. Thesis
John Allen Underwood 1977 170 p
Avail: Univ. Microfilms Order No. 7807400

A model of the massive Yang-Mills field was developed, utilizing indefinite metric fields, which is renormalizable but does not employ spontaneous symmetry breakdown. One of the extra fields required is a physical massless scalar. In spite of the explicit Yang-Mills mass term, the Lagrangian possesses a distorted gauge symmetry which reduces to the usual SU(2) gauge symmetry when this mass is zero. Explicit calculations were performed at the one and two loop level to check unitarity of the vector boson self energy. As an additional calculation, in an appendix the unitarity and gauge invariance of the graviton self energy is similarly tested to one loop in the class of linear harmonic gauges. Dissert Abstr.

N78-26904# Battelle Pacific Northwest Labs., Richland, Wash.
HISTORY OF PROTOTYPE HIGH LEVEL WASTE CANISTER SS-9 WHILE IN AIR AND WATER STORAGE
D. J. Bradley Nov. 1977 39 p refs
(Contract EY-76-C-06-1830)
(PNL-2278) Avail: NTIS HC A03/MF A01

From metallography failure was shown to be due to stress-assisted intergranular attack enhanced by metal sensitization during the hot air storage period, and a high chloride ion concentration in the canister storage water. Cores were taken

from Canister SS-9 and the leach rate of the material in deionized water was determined to be .00051 g/sq cm day for the first day. Averaged over 90 days, the material leach rate was 0.000031 g/sq cm - day. ERA

N78-26905# Brown Univ., Providence, R. I. Dept. of Physics.
A RESEARCH PROGRAM IN THEORETICAL HIGH-ENERGY PHYSICS Progress Report
David Feldman, Herbert M. Fried, Gerald S. Guralnik, Kyungsik Kang, and Chung I. Tan 1 Oct. 1977 15 p refs
(Contract EY-76-C-02-3130)
(COO-3130TA-340; Brown-HET-358) Avail: NTIS HC A02/MF A01

The following topics are discussed: hadron dynamics (Pomeron interaction in the eikonal approximation, estimates of all eikonal pionization graphs, study of the critical behavior in Reggeon field theory, status of Regge pole models in KN scattering); phenomenology of renormalizable gauge theory (tests of flavor mixing, dimuon events, SU(3) gauge model with unmixed quarks, lepton models, CP violation, neutrino magnetic moment); spectral sum rules (axial-vector masses, mixing angles); application of the self-consistent field approximation to relativistic quantum field theory; topics in gravitation and cosmology; as well as other studies involving elementary particle interactions. ERA

N78-26906# Bernische Kraftwerke A. G. (Switzerland).
COMPLETION OF THE FUEL CYCLE IN SMALL COUNTRIES
P. Stoll 1977 7 p refs In ENGLISH and GERMAN Presented at Reactor Conf. of the Ger. Atom Forum and Nucl. Technol. Soc., Mannheim, Ger., 29 Mar. - 1 Apr. 1977
(CONF-770323-5) Avail: NTIS HC A02/MF A01

Problems involving fuel cycle competition for various countries by means of contracts with national reprocessing installations are discussed. Possible solutions are presented as the following: (1) Enlargement of the capabilities of in house fuel element storage basins and intermediate storage; and (2) Construction and operation of central storage for spent fuel elements.
Author (ERA)

N78-26907# Columbia Univ., New York. Dept. of Mechanical and Nuclear Engineering.
NEUTRON SPECTROSCOPY Progress Report, 1 Oct. 1976 - 30 Sep. 1977
W. W. Havens, Jr., E. Melkonian, and J. Felvinici 1977 46 p refs
(Contract EY-76-S-02-2176)
(COO-2176-45) Avail: NTIS HC A03/MF A01

A new data acquisition system based on the PDP-11 was used to measure coincident double energy fission fragments as a function of neutron time-of-flight for Th-229, U-235 and Pu-239. Data is also obtained in the thermal energy region. Extensive results are reported on the 1972 Th-229 measurements with 2 families of widely differing fission widths. Earlier results on the variation of the ratio of symmetric to asymmetric mass division on PU-239 fission were confirmed. Variations in the total kinetic energies of U-235 resonances were seen. An experiment using CF-252 and measuring the energy of two coincident fission fragments and the time-of-flight of one of them was started. Work on the adaption of the code MULTI to the Columbia University computer was continued. ERA

N78-26908# California Univ., Berkeley. Lawrence Berkeley Lab.
NUCLEAR COLLISIONS AT VERY HIGH ENERGY
Norman K. Glendenning 31 Aug. 1977 31 p refs Presented at Symp. on Future Accelerators, Bombay, 19 Sept. 1977
(Contract W-7405-eng-48)
(LBL-6597; Conf-770995-1) Avail: NTIS HC A03/MF A01

Topics covered include: the equation of state and energy thresholds; two classes of high energy nucleus-nucleus collisions; the kinetics of a central collision, elementary particles; and the possible determination of the hadronic mass spectrum by high energy nuclear collisions. ERA

N78-26909# Stanford Linear Accelerator Center, Calif.
SUMMARY TALK: NEUTRINO 1977
J. D. Bjorken Aug. 1977 24 p refs Presented at Intern. Conf. on Neutrino Phys. and Neutrino Astrophysics, Elbrus, USSR, 18 Jun. 1977
(Contract EY-76-S-03-0326)
(SLAC-PUB-1996; Conf-770696-5) Avail: NTIS HC A02/MF A01

The summary of neutrino physics includes astrophysics, charm, the heavy lepton tau, more building blocks, understanding of the structure functions, the correctness of the standard SU(2) x U(1) model, and exotica as seen from a particular gauge theory. ERA

N78-26851*# Illinois Inst. of Tech., Chicago.
REVIEW OF COAXIAL FLOW GAS CORE NUCLEAR ROCKET FLUID MECHANICS
Herbert Weinstein *In* Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 123-135 refs (For availability see N78-26837 17-70)
(Grant NsG-7039)
Avail: NTIS HC A13/MF A01 CSCL 21F

N78-26855*# Brookhaven National Lab., Upton, N. Y.
STUDIES ON COLOR-CENTER FORMATION IN GLASS UTILIZING MEASUREMENTS MADE DURING 1 TO 3 MeV ELECTRON IRRADIATION
K. J. Swyler and P. W. Levy *In* Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 160-169 refs Sponsored in part by DOE (For availability see N78-26837 17-70)
(BNL-21531) Avail: NTIS HC A13/MF A01 CSCL 20H

N78-26858*# United Technologies Research Center, East Hartford, Conn.
PARAMETRIC ANALYSES OF PLANNED FLOWING URANIUM HEXAFLUORIDE CRITICAL EXPERIMENTS
R. J. Rodgers and T. S. Latham *In* Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 188-196 refs (For availability see N78-26837 17-70)
(Contract XP5-54474-1)
Avail: NTIS HC A13/MF A01 CSCL 18K

N78-26859*# United Technologies Research Center, East Hartford, Conn. Power Systems Technology Section.
CIRCULATION SYSTEM FOR FLOWING URANIUM HEXAFLUORIDE CAVITY REACTOR EXPERIMENTS
J. F. Jaminet and J. S. Kendall *In* Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 197-204 refs (For availability see N78-26837 17-70)
(Contracts XP4-54459-1; XP5-54474-1)
Avail: NTIS HC A13/MF A01 CSCL 18K

N78-26866*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
UF6 BREEDER REACTOR POWER PLANTS FOR ELECTRIC POWER GENERATION
J. H. Rust (Ga. Inst. of Tech., Atlanta), J. D. Clement (Ga. Inst. of Tech., Atlanta), and F. Hohl *In* Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 248-254 refs (For availability see N78-26837 17-70)
(Grants NsG-7068; NsG-1168)
Avail: NTIS HC A13/MF A01 CSCL 18L

N78-26867*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
GEORGIA INSTITUTE OF TECHNOLOGY RESEARCH ON THE GAS CORE ACTINIDE TRANSMUTATION REACTOR (GCATR)
J. D. Clement, J. H. Rust, A. Schneider, and F. Hohl *In* Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 255-262 refs Prepared in cooperation with Ga. Inst. of Tech., Atlanta (For availability see N78-26837 17-70)
Avail: NTIS HC A13/MF A01 CSCL 18K

N78-26868*# Florida Univ., Gainesville.
APPLICATION OF GASEOUS CORE REACTORS FOR TRANSMUTATION OF NUCLEAR WASTE
B. G. Schnitzler, R. R. Paternoster, and R. T. Schneider *In* Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 263-268 refs (For availability see N78-26837 17-70)
Avail: NTIS HC A13/MF A01 CSCL 18G

74 OPTICS

Includes light phenomena.

N78-26910 Stanford Univ., Calif.
AN ANALYSIS OF THE DEPTH RESOLUTION PROBLEM IN ONE-DIMENSIONAL CODED APERTURE IMAGING Ph.D. Thesis
Arden Lynn Steinbach 1978 107 p
Avail: Univ. Microfilms Order No. 7808850

A detailed analysis is given of a one-dimensional coded aperture imaging system which images a two-dimensional slice through a more general three-dimensional source distribution. A rigorous expression for the point spread function associated with the combined encoding-decoding process is derived. It is demonstrated that the Fresnel zone plate is only one of a large class of aperture codes which, when combined with suitable decoding functions, allow the realization of depth resolution. For the two aperture codes considered, a least squares procedure is used to determine optimum decoding functions which minimize the mean square magnitude of the sidelobes of the point spread functions. The replacement of the initial decoding functions by their optimized counterparts leads to point spread functions which not only oscillate rapidly in sign (thus minimizing the buildup of background), but also have mean square sidelobe magnitudes which are smaller by a factor of two. Dissert. Abstr.

N78-26911 Stanford Univ., Calif.
GENERATION OF COHERENT EXTREME ULTRAVIOLET RADIATION Ph.D. Thesis
Kwei-Sun Hsu 1978 89 p
Avail: Univ. Microfilms Order No. 78-08801

300 Watts of 1202.8 A radiation was generated in Hg by resonantly enhanced four-wave mixing, and an efficiency of 0.5% was obtained. Higher harmonic processes to generate the fifth and seventh harmonics, 532 A and 381 A, respectively, of 2660 A radiation were repeated. Photons at 532 A and at 381 A were generated in a He cell with focused 2660 A radiation. A conversion efficiency of 10 to the minus 7 power for the fifth order process was obtained. The efficiency of the seventh order process was about 100 times less. Theoretical analysis of inner shell ionization in Rb and charge exchange transfer in He to obtain direct laser action in 697 A and 584 A radiation is described. A proposed technique to generate coherent Lyman alpha radiation by four-wave mixing in Xe is also discussed. Extension of the spectral range of the nonlinear processes in a positively dispersive medium by introducing appropriate differential pumping is reported. Dissert. Abstr.

N78-26912# Optical Sciences Co., Placentia, Calif.
ANALYSIS OF TECHNIQUES FOR IMAGING THROUGH THE ATMOSPHERE Interim Report, May - Oct. 1977
David L. Fried Mar. 1978 24 p
(Contract F30602-77-C-0021; ARPA Order-2646)
(AD-A053147; RADC-TR-78-20) Avail: NTIS HC A02/MF A01 CSCL 17/8

This report is the second interim technical report on the problem of generating appropriate one-dimensional slices of a target object. Methods are developed for generating these image patterns for subsequent use in a simulation of a one-dimensional version of the nonstationary postdetection compensation technique described in the previous interim technical report. The resulting one-dimensional image will correspond to a 1/n-squared power spectrum target object with randomly chosen target details. GRA

N78-26913# Oak Ridge Y-12 Plant, Tenn.
MECHANICAL DEFLECTION ANALYSIS OF DIAMOND-TURNED REFLECTIVE OPTICS
J. E. Stoneking (Tenn. Univ.) and H. L. Gerth Dec. 1977 23 p refs Presented at the Electro-Optics/Laser Conf. and Exposition, Anaheim, Calif., 25-27 Oct. 1977
(Contract W-7405-eng-26)
(Y-2108) Avail: NTIS HC A02/MF A01

The amount of warpage caused by various support and loading conditions imposed by the diamond turning process in the fabrication of metal reflective mirrors used in laser fusion was predicted. The finite-element method was used to compute mirror surface displacements resulting from these support and load conditions. Surface warpage was then determined by a best-fit comparison of these data to the desired surface contour. The technique is not limited to diamond turning, but can be used to predict warpage from a variety of loading conditions placed on the mirrors. ERA

N78-26914# Oxford Univ. (England). Engineering Lab.
ANALYSIS OF A ONE DIMENSIONALLY-CONFINED PLANAR OPTICAL DIRECTIONAL COUPLER
P. S. J. Russell [1977] 34 p refs
(OUEL-1211/77) Avail: NTIS HC A03/MF A01

A one dimensionally-confined optical waveguide was analyzed and the dispersion relation derived. Omega-beta diagrams and field shapes were computed and plotted; then the analysis was extended to two of these guides placed parallel to one another, operating as an optical co-directional coupler. Omega-beta diagrams were again plotted for a particular case, then coupling lengths (for eigenmode excitation) and cutoff frequencies were plotted for a variety of guide separations and refractive index values. These latter results will be useful as qualitative guidelines towards the design of a practical optical directional coupler. Author (ESA)

75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.
For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

N78-26915 Texas Univ., Austin.
AN EXPERIMENTAL STUDY OF THE TEXAS TURBULENT TORUS Ph.D. Thesis
Regan White Stinnett 1977 204 p
Avail: Univ. Microfilms Order No. 7807390

Both the preheat and turbulent phase plasmas were studied using microwave interferometry, Langmuir probe scans, Thompson scattering, microwave radiation detection, and an E x B velocity analyzer to obtain a picture of the evolution of the plasma during both phases of the discharge. A preheat plasma was subjected to a large toroidal electric field during the turbulent phase. The electron velocity distribution was measured during turbulent heating. During the turbulent phase of the discharge large heating rates were observed together with rapid energy losses from the edge of the plasma and less rapid losses from the interior. Dissert. Abstr.

N78-26916 California Univ., Davis.
ELECTROSTATIC BOUNCE MODES IN MIRROR PLASMAS Ph.D. Thesis
William Martin Sharp 1977 119 p
Avail: Univ. Microfilms Order No. 7809256

Standing waves are considered that occur in a mirror plasma when the relative spread in electron bounce frequencies is small. After a review of theoretical work on electrostatic waves in mirror plasmas, a general matrix eigenvalue equation for the wave potential was derived which account accurately for electron histories and which includes the ion response. A computer program for calculating the plasma eigenmodes and the associated threshold densities for instability and maximum growth rates is then described. Strong resonances at harmonics of the electron bounce frequency were found when that frequency is well defined. These resonances resulted from phase correlations between electrons on successive transits through the plasma, and they

were weakened and shifted in frequency when the mirror force and spatial variation of the ambipolar potential spread the bounce frequencies. The effects of plasma and field parameters on the eigenmodes are discussed. Dissert. Abstr.

N78-26917 Princeton Univ., N. J.
THOMSON SCATTERING MEASUREMENTS OF PLASMA TURBULENCE NEAR QUARTER-CRITICAL DENSITY IN A CO2 LASER-HEATED GAS TARGET PLASMA Ph.D. Thesis
Jack Jerome Schuss 1978 145 p
Avail: Univ. Microfilms Order No. 78-07497

Ruby laser Thomson scattering is used to obtain data on plasma density and temperature. This diagnostic revealed a strongly nonthermal level of plasma turbulence at one half the CO2 laser frequency, which was attributed to the parametric decay of the CO2 laser light into plasma waves. The theory of laser driven parametric instabilities relevant to this experiment is reviewed, with particular attention paid to the two plasmon parametric decay. It is theoretically demonstrated that the threshold condition for this decay is relaxed if the pump wave is obliquely incident on the density gradient. Thomson scattering theory relevant to this experiment is summarized and the effect of temporal and spatial variations in the plasma density is calculated. Dissert. Abstr.

N78-26918 California Univ., Davis.
NON-LINEAR NUMERICAL STUDIES OF THE TEARING MODE Ph.D. Thesis
Dalton Dewitt Schnack, Jr. 1977 232 p
Avail: Univ. Microfilms Order No. 78-09254

A non-linear, time dependent, hydromagnetic model is developed and applied to the tearing mode, one of a class of instabilities which can occur in a magnetically confined plasma when the constraint of infinite conductivity is relaxed. The model is based on the eight partial differential equations of resistive magnetohydrodynamics (MHD). The equations are expressed as a set of conservation laws which conserves magnetic flux, momentum, mass, and total energy. These equations are then written in general, orthogonal, curvilinear coordinates in two space dimensions, so that the model can readily be applied to a variety of geometries. No assumption about the ordering of terms is made. The resulting equations are then solved by the method of finite differences on an Eulerian mesh. Dissert. Abstr.

N78-26919 Tennessee Univ., Knoxville.
AN UNUSUALLY STABLE HOT ELECTRON RING IN A HOT ELECTRON PLASMA CONFINED IN A MAGNETIC MIRROR Ph.D. Thesis
Marshall Lee Saylors 1977 97 p
Avail: Univ. Microfilms Order No. 7807721

A ring of highly energetic electrons formed in close proximity to conducting walls in a simple magnetic mirror was observed. The ring is stable for times which are consistent with classical coulomb scattering. The ring is stable at pressures below the Guest-Harris criterion and in the absence of line tying to the end walls. The ring is observed to be stable only when it is formed in close proximity to conducting side walls. A series of experiments in which the ring was forced away from the wall is described. In each case the ring became grossly unstable. Two stabilizing mechanisms in which image charges and currents play a dominant role are suggested. Dissert. Abstr.

N78-26920 Tennessee Univ., Knoxville.
LINEAR AND NONLINEAR INTERACTIONS OF MICROWAVE RADIATION NEAR THE ELECTRON CYCLOTRON FREQUENCY IN PLASMAS Ph.D. Thesis
Won Namkung 1977 120 p
Avail: Univ. Microfilms Order No. 7807712

The interactions of microwave near the electron cyclotron frequency with plasmas are investigated by linear wave-particle and nonlinear wave-wave interaction theories for Tokamaks and the Elmo Bumpy Torus (EBT). A new omega-contour method for dispersion relation of electrostatic waves was introduced in order to find threshold values of parametric decay instabilities near the upper hybrid frequency. The parametric excitation theory of electrostatic waves was extended to include harmonic frequencies of the pump wave in the absence of any plasma resonances at the pump frequency. Half-harmonic electron cyclotron heating of Tokamak plasmas is considered via second harmonic frequency excitation driven by E x B drift of powerful microwave irradiation. Dissert. Abstr.

N78-26921 Maryland Univ., College Park.
STARK BROADENING OF NEUTRAL HELIUM LINES IN A PLASMA Ph.D. Thesis
Daniel Edward Kelleher 1977 157 p
Avail: Univ. Microfilms Order No. 7808193

Side-on observations of the visible spectrum emitted by a helium plasma generated in a wall-stabilized arc are reported. The widths and shifts of all but one of the seventeen measured neutral helium lines were predominately determined by Stark effects caused by the electric field of the charged particles in the plasma. Fourteen of these lines were isolated at momentum quantum levels which are separated by an amount greater than the energy of interaction with the perturbing fields. Electron densities derived from the Stark-widths of the isolated lines agree to within 15% of the values determined from H sub beta and from the quasi-degenerate Hel lines at 4471 and 4921 A. Dissert. Abstr.

N78-26922 Idaho Univ., Moscow.
LASER-DOPPLER VELOCIMETER STUDIES OF MHD ENTRANCE FLOWS Ph.D. Thesis
Akio Hama 1977 315 p
Avail: Univ. Microfilms Order No. 7808207

Laminar and turbulent MHD channel flows of a KOH aqueous solution were investigated in the presence of a uniform transverse magnetic field. Measurements of velocity profiles were conducted with a laser-doppler velocimeter mounted on a traversing mechanism to allow for complete three dimensional measurements. The accuracy of the velocity measurements was examined by comparing velocity data in water flows with experimental data obtained with a hot-wire anemometer by other investigators. Agreement between the time-smoothed velocity profiles was quite remarkable. Dissert. Abstr.

N78-26923 New Mexico State Univ., University Park.
COLLISION EFFECTS ON FLUCTUATION SPECTRUM AND DRIFT INSTABILITIES IN PARTIALLY IONIZED PLASMAS Ph.D. Thesis
Yugal Kishore Behl 1977 61 p
Avail: Univ. Microfilms Order No. 7807993

A method to calculate the collective fluctuation spectrum of the electron density in a plasma is presented. The method is based on the following three general principles: the linear response of a plasma to a weak electric field, the special Nyquist theorem, and the principle of causality in the form of the Hilbert transform relations; a new principle is deduced from the preceding ones. Together the four principles allow one to calculate the collective fluctuation spectrum from the random fluctuation spectrum alone. Dissert. Abstr.

N78-26924 Stanford Univ., Calif.
CURRENT-SHEAR STABILIZATION OF THE TEARING MODE INSTABILITY: A NUMERICAL SIMULATION Ph.D. Thesis
Robert James Barker 1978 104 p
Avail: Univ. Microfilms Order No. 7808760

A fully-relativistic stream superposition model is employed to conduct a linear, one-dimensional, numerical simulation of a self-consistently confined sheet of plasma whose current density vector is sheared. The plasma is assumed to be collisionless and electrically neutral but otherwise no a priori restrictions are imposed. The simulation was reduced to a one-dimensional problem through Fourier analysis in the two homogeneous dimensions of the equilibrium sheet. To determine the perturbations in the current density the numerical algorithm relies on lengthy integrations in three-dimensional momentum space of a variable termed the canonical momentum potential or action function. Growth rates obtained for the tearing mode instability for the classic sheet pinch without current shear are in close agreement with those predicted analytically through an approximate Vlasov approach. Dissert. Abstr.

N78-26925 Brown Univ., Providence, R. I.
HYDRODYNAMIC RESPONSE IN FINITE MULTI-COMPONENT PLASMAS Ph.D. Thesis
Frank Joseph Crowne, Jr. 1977 227 p
Avail: Univ. Microfilms Order No. 78-09048

A semi-classical approach is taken to the problem of plasmas in solids, using hydrodynamic constitutive equations plus standard electromagnetic theory. The plasmas considered were bounded by surfaces, which were modeled by discontinuous boundaries at which the hydrodynamic variables satisfy certain boundary conditions. The response of these plasmas to an external perturbation was obtained, and then related to the quantum correlations associated with the quantized normal modes of the system--plasmons--via Van Hove's method. A technique is derived for generating the various material parameters which enter into the plasma constitutive equations from miscroscopic considerations. Some discussion is given of applications to electron and Raman scattering. Dissert. Abstr.

N78-26926*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A FLUCTUATION-INDUCED PLASMA TRANSPORT DIAGNOSTIC BASED UPON FAST-FOURIER TRANSFORM SPECTRAL ANALYSIS
E. J. Powers (Texas Univ., Austin), Y. C. Kim (Texas Univ., Austin), J. Y. Hong (Texas Univ., Austin), J. R. Roth, and W. M. Krawczonek 1978 18 p refs Presented at the Intern. Conf. on Plasma Sci., Monterey, Calif., 15-18 May 1978; sponsored by IEEE
(NASA-TM-78932; E-9675) Avail: NTIS HC A02/MF A01 CSCL 20I

A diagnostic, based on fast Fourier-transform spectral analysis techniques, that provides experimental insight into the relationship between the experimentally observable spectral characteristics of the fluctuations and the fluctuation-induced plasma transport is described. The model upon which the diagnostic technique is based and its experimental implementation is discussed. Some characteristic results obtained during the course of an experimental study of fluctuation-induced transport in the electric field dominated NASA Lewis bumpy torus plasma are presented.
A.R.H.

N78-26927*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FLUCTUATION SPECTRA IN THE NASA LEWIS BUMPY-TORUS PLASMA
Chandra M. Singh, Walter M. Krawczonek, J. Reece Roth, Jae Y. Hong, and Edward J. Powers Jun. 1978 31 p refs
(NASA-TP-1257; E-8696) Avail: NTIS HC A03/MF A01 CSCL 20I

The electrostatic potential fluctuation spectrum in the NASA Lewis bumpy-torus plasma was studied with capacitive probes in the low pressure (high impedance) mode and in the high pressure (low impedance) mode. Under different operating conditions, the plasma exhibited electrostatic potential fluctuations (1) at a set of discrete frequencies, (2) at a continuum of frequencies, and (3) as incoherent high-frequency turbulence. The frequencies and azimuthal wave numbers were determined from digitally implemented autopower and cross-power spectra. The azimuthal dispersion characteristics of the unstable waves were examined by varying the electrode voltage, the polarity of the voltage, and the neutral background density at a constant magnetic field strength. Author

N78-26928# California Univ., Livermore. Lawrence Livermore Lab.
PROPOSED E-BEAM STABILIZATION OF NEUTRAL BEAM SUSTAINED MIRROR PLASMAS
B. Grant Logan 1 Nov. 1977 28 p refs
(Contract W-7405-eng-48)
(UCID-17633) Avail: NTIS HC A03/MF A01

A proposed method of stabilization of neutral beam sustained mirror plasmas by E-beam injection is extensively discussed. The E-beam experiment at MIT wherein the method is demonstrated is summarized. The results of this experiment are compared with Ryutov's theory of E-beam plasma stabilization and Ioffe's microwave heating method. The feasibility of E-beam stabilization in dense, high-beta mirror experiments at LLL is analyzed. A proposed experiment using a magnetron injection gun in a dense, high beta plasma stabilization experiment is described.
ERA

N78-26929# Princeton Univ., N. J.
OHMIC HEATING SYSTEM FOR THE TFTR TOKAMAK
F. Petree (Ebasco Services, Inc., N. Y.) and R. Cassel 1977 5 p refs Presented at 7th Symp. on Fusion Res. Project, Knoxville, Tenn., 25 Oct. 1977
(Contract EY-76-C-02-3073)
(CONF-771029-173) Avail: NTIS HC A02/MF A01

One hundred thousand volt impulses will be applied to the ohmic system (OH) coils to start the plasma in the Tokamak fusion test reactor. In order to reduce the voltage stress to ground on the OH coils to 12 kV without changing the magnetic field induced by the OH system in the plasma, six dc current interrupters will be applied to six entry points in the OH coil system. To impart a nearly rectangular shape to these impulses, the voltage determining elements will be nonlinear resistances placed in parallel with the interrupters. These nonlinear resistors, made of semiconducting material are not normally used in repetitive or continuous duty, and their proper functioning is crucial to the reliable operation of the system. The system described is being revised owing to the impact of revisions to the toroidal field coil system, and to refinements to the OH system design. ERA

N78-26930# Princeton Univ., N. J. Plasma Physics Lab.
DEVELOPMENT OF THE TFTR NEUTRAL BEAM INJECTION SYSTEM
B. A. Prichard, Jr. 1977 5 p refs Presented at Workshop on Fusion Fueling, Princeton, N. J., 1 Nov. 1977
(Contract EY-76-C-02-3073)
(CONF-771129-7) Avail: NTIS HC A02/MF A01

The implementation of the Tokamak fusion test reactor (TFTR) neutral beam lines which are designed to inject 20 MW of 120 KeV neutral deuterium atoms into the plasma, requires the development of the following associated pieces of hardware: (1) 200 kV switch tubes for modulation and regulation of the accelerating power supplies; (2) 90 cm metallic seal gate valve capable of sealing against atmosphere in either direction for separating the torus and beam line vacuum systems; (3) a 70 x 80 cm fast shutter valve to limit tritium migration from the torus into the beam line; (4) a calorimeter, ion dump and deflection magnet to handle three beams; and (5) optical diagnostics utilizing the Doppler broadening and Doppler shift of light emitted from the accelerated beam. The control and monitoring of the 12 sources will be done via the TFTR computer control system.
ERA

N78-26931# California Univ., Livermore. Lawrence Livermore Lab.
HIGH PERFORMANCE INERTIAL FUSION TARGETS
J. H. Nuckolls, R. O. Bangerter, J. D. Lindl, W. C. Mead, and Y. L. Pan 24 Aug. 1977 19 p refs Presented at 11th European Conf. on Laser Interaction with Matter, Oxford, England, 19 Sep. 1977
(Contract W-7405-eng-48)
(UCRL-79373; Conf-770945-6) Avail: NTIS HC A02/MF A01

Inertial confinement fusion (ICF) designs are considered which may have very high gains (approximately 1000) and low power requirements (<100 TW) for input energies of approximately one megajoule. These include targets having very low density shells, ultra thin shells, central ignitors, magnetic insulation, and nonablative acceleration. ERA

N78-26932# California Univ., Berkeley. Lawrence Berkeley Lab.
APPLICATIONS OF INDUCTION LINAC TECHNOLOGY TO HEAVY ION FUSION
A. Faltens and D. Keefe Jul. 1977 10 p refs Presented at the 10th Intern. Conf. on High Energy Accelerators, Serpukhov, USSR, 11 Jul. 1977
(Contract W-7405-eng-48)
(LBL-6453; Conf-770709-15) Avail: NTIS HC A02/MF A01

The application of heavy ion accelerators to ignite d-t pellets in a thermonuclear reactor is evaluated. Accelerator design requirements considered include transport-limited current, beam

injection conditions, and pulse bunching and focusing characteristics. The desirability of resonant and non-resonant accelerating structures is comparatively examined and the required power system switch tubes are discussed. The advantages of heavy ion accelerators include electric efficiency greater than 10 percent, the possibility of high repetition rates (1 to 10 Hz), and a mature technological base. ERA

N78-26933# Argonne National Lab., Ill.
STUDIES ON TWO-PHASE FLOW MIXING PERTAINING TO LIQUID-METAL MAGNETOHYDRODYNAMIC POWER GENERATION
G. Fabris, P. F. Dunn, J. C. F. Chow, and R. Kolp 1977 11 p refs Presented at 5th Biennial Symp., Rolla, Mo., 2 Oct. 1977
(Contract W-31-109-eng-38)
(CONF-771098-1) Avail: NTIS HC A02/MF A01

The local flow structure occurring inside two-phase mixers liquid-metal magnetohydrodynamic (LMMHD) mixers and generators was investigated to determine the relation between the characteristics of local two-phase flow structure at high void fractions (approximately 0.6 to approximately 0.9) and LMMHD power generation system efficiency. Evaluations of the fluid mechanical performance of various two-phase LMMHD mixer designs are discussed. The finding from flow visualization studies of the local two-phase flows downstream from various mixer-element configurations are presented in addition to the local measurements performed to characterize these flows. ERA

N78-26934# Argonne National Lab., Ill.
NEUTRAL BEAM SYSTEM FOR AN IGNITION TOKAMAK
J. Fasolo, R. Fuja, J. Jung, J. Moenich, J. Norem, W. Praeg, and H. Stevens 1977 10 p refs Presented at 7th Symp. on Fusion Res. Project, Knoxville, Tenn., 25 Oct. 1977
(Contract W-31-109-eng-38)
(CONF-771029-177) Avail: NTIS HC A02/MF A01

Attempts were made to produce detailed designs of several neutral beam systems which would be applicable to a large machine, e.g., an ITR (Ignition Test Reactor), EPR (Experimental Power Reactor), or reactor. Detailed studies of beam transport to the reactor and neutron transport from the reactor were also made. The investigation considered constraints imposed by the neutron radiation environment in the injectors, and the resulting shielding, radiation-damage, and maintenance problems. The effects of neutron heat loads on cryopanels and ZrAl getter panels were studied. ERA

N78-26935# Energy Research and Development Administration, Washington, D. C. Div. of Magnetohydrodynamics.
MHD STUDIES CONDUCTED AT THE U-25 FACILITY (V)
1977 92 p refs Presented at the US-USSR Committee for Cooperation in MHD Power Generation, Washington, D.C., 13-21 Apr. 1977
(CONF-770402-2) Avail: NTIS HC A05/MF A01

The U-25 facility research status is summarized. The main rated parameters of the U-25 facility were attained and the main stages of the facility shakedown are briefly discussed. Experimental studies focused on design of the RM frame channel, development of a method for processing experimental data obtained at the U-25 facility, study of the seed injection/removal system, and steam generator studies. ERA

N78-26838*# Princeton Univ., N. J.
ON THE EMISSION MECHANISM IN HIGH CURRENT HOLLOW CATHODE ARCS
M. Krishnan *In its* Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 8-23 refs (For availability see N78-26837 17-70)
Avail: NTIS HC A13/MF A01 CSCL 20I

N78-26839*# Princeton Univ., N. J.
A SCALING LAW FOR ENERGY TRANSFER BY INELASTIC ELECTRON-MOLECULE COLLISIONS IN MIXTURES
George K. Bienkowski *In its* Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 24-31 refs (For availability see N78-26837 17-70)
Avail: NTIS HC A13/MF A01 CSCL 20I

N78-26840*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PULSER-SUSTAINER GLOW DISCHARGE OPERATION IN STATIC CARBON MONOXIDE LASER MIXTURES
Daryl J. Monson and Craig M. Lee *In* Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 32-36 refs (For availability see N78-26837 17-70)
Avail: NTIS HC A13/MF A01 CSCL 20I

N78-26841*# Colorado State Univ., Fort Collins. Dept. of Mechanical Engineering and Physics.
PLASMA RESEARCH IN ELECTRIC PROPULSION AT COLORADO STATE UNIVERSITY
Paul J. Wilbur and Harold R. Kaufman *In* Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 37-47 refs (For availability see N78-26837 17-70)
Avail: NTIS HC A13/MF A01 CSCL 20I

N78-26842*# Politecnico di Milano (Italy). Dept. of Nuclear Engineering.
AN EFFICIENT PROCEDURE FOR COMPUTING PARTIAL IONIZATION OF A GAS IN NUMERICAL FLUID DYNAMICS
S. Garribba and L. Quartapelle (EURATOM, Ispra) *In* Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 48-51 refs (For availability see N78-26837 17-70)
(Contract EURATOM-109-73-PIPGI)
Avail: NTIS HC A13/MF A01 CSCL 20I

N78-26843*# North Carolina State Univ., Raleigh. Dept. of Mechanical and Aerospace Engineering.
ANALYSIS OF NUCLEAR INDUCED PLASMAS
Jerry E. Deese and H. A. Hassan *In* Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 52-63 refs (For availability see N78-26837 17-70)
(Grant NsG-1058)
Avail: NTIS HC A13/MF A01 CSCL 20I

N78-26844*# Illinois Univ., Urbana. Nuclear Engineering Program.
ENERGY DISTRIBUTIONS AND RADIATION TRANSPORT IN URANIUM PLASMAS
G. H. Miley, C. Bathke, E. Maceda, and C. Choi *In* Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 64-72 refs (For availability see N78-26837 17-70)
(Grant NsG-1063)
Avail: NTIS HC A13/MF A01 CSCL 20I

N78-26845*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
RECENT MEASUREMENTS CONCERNING URANIUM HEXAFLUORIDE-ELECTRON COLLISION PROCESSES
S. Trajmar, A. Chutjian, S. Srivastava, W. Williams, and D. C. Cartwright (LASL) *In* Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 73-79 refs (For availability see N78-26837 17-70)
(Contract NAS7-100; ERDA Order LS-76-5)
Avail: NTIS HC A13/MF A01 CSCL 20I

N78-26846*# Florida Univ., Gainesville.
MEASUREMENT TECHNIQUES FOR ANALYSIS OF FISSION FRAGMENT EXCITED GASES
R. T. Schneider, E. E. Carroll, J. F. Davis, R. N. Davie, T. C. Maguire, and R. G. Shipman *In* Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 80-90 refs (For availability see N78-26837 17-70)
Avail: NTIS HC A13/MF A01 CSCL 20I

N78-26852*# United Technologies Research Center, East Hartford, Conn. Fluid Dynamics Lab.
PROPERTIES OF RADIO-FREQUENCY HEATED ARGON CONFINED URANIUM PLASMAS
In Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 136-145 refs (For

availability see N78-26837 17-70)
(Contract NAS1-13291)
Avail: NTIS HC A13/MF A01 CSCL 20I

N78-26854*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
URANIUM PLASMA EMISSION AT GAS-CORE REACTION CONDITIONS
M. D. Williams, N. W. Jalufka, F. Hohl, and J. H. Lee (Vanderbilt Univ.) *In* Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 156-159 refs (For availability see N78-26837 17-70)
Avail: NTIS HC A13/MF A01 CSCL 20I

N78-26856*# Princeton Univ., N. J. Plasma Physics Lab.
HEAT TRANSFER EVALUATION IN A PLASMA CORE REACTOR
Donald E. Smith, Timothy M. Smith, and Maria L. Stoenescu *In its* Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 170-177 (For availability see N78-26837 17-70)
Avail: NTIS HC A13/MF A01 CSCL 20I

N78-26857*# Los Alamos Scientific Lab., N. Mex.
RESEARCH ON PLASMA CORE REACTORS
G. A. Jarvis, D. M. Barton, H. H. Helmick, William Bernard, and R. H. White *In* Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 178-187 refs (For availability see N78-26837 17-70)
(Contract NASw-13755)
Avail: NTIS HC A13/MF A01 CSCL 20I

N78-26860*# United Technologies Research Center, East Hartford, Conn. Power Systems Technology Section.
MEASUREMENTS OF URANIUM MASS CONFINED IN HIGH DENSITY PLASMAS
R. C. Stoeffler *In* Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 205-210 refs (For availability see N78-26837 17-70)
(Contract NAS1-13291)
Avail: NTIS HC A13/MF A01 CSCL 20I

N78-26863*# United Technologies Research Center, East Hartford, Conn.
PLASMA CORE REACTOR APPLICATIONS
T. S. Latham and R. J. Rodgers *In* Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 224-238 refs (For availability see N78-26837 17-70)
(Contract NAS1-13291)
Avail: NTIS HC A13/MF A01 CSCL 20I

76 SOLID-STATE PHYSICS

Includes superconductivity.

For related information, see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

N78-26936 Texas Univ., Austin.
THE REFLECTANCE OF LIQUID GALLIUM-, INDIUM-, AND THALLIUM-TELLURIUM ALLOYS
Donald McLean Trotter 1977 164 p
Avail: Univ. Microfilms Order No. 78-07398

Alloys in the systems Ga sub 1-x Te sub x, In sub 1-x Te sub x, and Tl sub 1-x Te sub x are all liquid semiconductors over a wide range of composition. Their dc transport and other properties are anomalous at or near the compositions Ga2Te3 In2Te3 and Tl2Te. Measurements of the reflectance for photon energies between 0.65eV and 3.00eV of a number of alloys in each of those systems showed a smooth small gap semiconductor-large gap semiconductor-metal transition as the compositions of the alloys were varied from pure Te to pure metal. The data were fitted by both a three-parameter oscillator model and a thirteen-parameter oscillator model. The thirteen-parameter model fitted the data very well. Only the real and imaginary parts of the dielectric function of the fitted model were used to confirm the small gap semiconductor-large gap semiconductor-metal transition evident in the raw data. Dissert. Abstr.

N78-26937 Brown Univ., Providence, R. I.
APPROXIMATE RENORMALIZATION GROUP CALCULATIONS OF CUBIC CROSSOVER Ph.D. Thesis
Mehmet Cemal Yalabik 1977 96 p
Avail: Univ. Microfilms Order No. 78-09102

The effect of a small cubic anisotropic interaction near the critical point of an isotropic spin system is analyzed with the use of a variational renormalization group approximation. The transformation used is the one hypercube lower bound recursion. The equations for the isotropic fixed point and the anisotropic eigenperturbation were put in the form of one dimensional integral equations and were generalized for non-integer spin dimensionality n. These equations were then solved numerically for three space dimensions and as a by-product of this calculation, the critical index nu for the isotropic system is determined in the region d = 3 and 1 less than n less than 4. The values obtained for this exponent are in very good agreement with high temperature series results. Dissert. Abstr.

N78-26938 Clark Univ., Worcester, Mass.
THE ELECTRON SPIN RESONANCE STUDY OF X-IRRADIATED SINGLE CRYSTALS OF AMMONIUM CHLOROACETATE Ph.D. Thesis
Michiko Yoshihara 1978 190 p
Avail: Univ. Microfilms Order No. 7808662

Using perturbation theory, formulas have been derived for the positions and relative intensities of both allowed and forbidden transitions. Using this information, expected spectral patterns have been constructed for comparison with observed spectra. In certain orientations good correspondence is found and the formulas for line positions have then been applied to the observed spectral splittings to obtain values for the chlorine quadrupole coupling parameters. Using the same method of comparison of calculated and observed spectra, it has also been possible to determine the signs of chlorine hyperfine coupling parameters.
Dissert. Abstr.

N78-26939 Brown Univ., Providence, R. I.
FAST TRANSIENT REFLECTIVITY NEAR THE FREE CARRIER PLASMA EDGE IN SEMICONDUCTORS Ph.D. Thesis
Stephen Alan Jamison 1977 140 p
Avail: Univ. Microfilms Order No. 7809064

The generation of a dense electron-hole plasma in semiconductors by interband absorption of picosecond laser pulses can induce considerable transient wavelength shifts of the free carrier plasma edge. Such shifts have been studied here experimentally in Ge and GaAs by monitoring the rapid temporal variations of the surface reflectivity at 10.6 microns which occur after ultrashort excitation at 1.06 microns. From the measurement of the relative reflected energy of the infrared transient and the temporal autocorrelation function of the surface reflectivity the plasma diffusion and recombination dynamics can be studied in detail. The results of such transient reflectivity show that the method can be used as a sensitive diagnostic tool in the study of such parameters of carrier dynamics as ambipolar diffusivity and surface recombination velocity at high plasma densities in the absence of impurity effects.
Dissert. Abstr.

N78-26940 Princeton Univ., N. J.
SWITCHING, I/f NOISE AND TWO-ELECTRON CENTERS Ph.D. Thesis
Ki Bui Ma 1978 101 p
Avail: Univ. Microfilms Order No. 7807484

In the first portion, a discussion is given as to how a shrinkage of the energy gap in an amorphous semiconductor is implied by the Anderson Hamiltonian, and how such a shrinkage can lead to an instability as observed in ovonic switches. The remaining part treats I/f noise as fluctuations of the resistance, and presents a model in which this is due to the fluctuations in the total number of current carriers which interact simultaneously with many kinds of traps with widely different properties. An upper limit for the noise level is estimated. Dissert. Abstr.

N78-26941 Pennsylvania State Univ., University Park.
ELASTIC, PIEZOELECTRIC, DIELECTRIC, AND OPTICAL PROPERTIES OF LEAD POTASSIUM NIOBATE Ph.D. Thesis
William Frank Regnault 1977 164 p
Avail: Univ. Microfilms Order No. 7808414

The single crystal elastic, thermoelastic, dielectric, piezoelectric, and optical properties were measured for lead potassium niobate (Pb2KNb5O15). The elastic and piezoelectric constants were measured by means of the ultrasonic pulse superposition method. The temperature for the ferroelectric phase transition was measured optically as a function of chemical composition and was found to vary from 300 to 500 C over a small compositional range in the vicinity of the stoichiometric composition. The polarized Raman spectra were observed in this crystal with the intent of studying the mechanism of the ferroelectric phase transformation. Dissert. Abstr.

N78-26942 Texas Univ. at Austin.
INTERFACIAL SILICIDE FORMATION IN NICKEL-SILICON THIN FILM COUPLES Ph.D. Thesis
William Joseph Schaffer 1977 137 p
Avail: Univ. Microfilms Order No. 7807379

Thin films of nickel are r-f sputtered onto cold, clean substrates of (100) and (111) oriented n type silicon wafers in the thickness range 10A to 6800A. Interfacial silicides are formed either upon deposition or by heat treating in vacuum in annealing cycles as long as 24 hours at temperatures as high as 650 C. The films are characterized using X-ray diffraction for compound identification, Auger electron spectroscopy (AES) for depth profiling and transmission electron diffraction (TED) for structure determination. An interfacial glass between adjacent silicides and substrate is postulated. Thicker films deposited onto both (100) and (111) oriented silicon show immediate silicide formation. Sputter etching is not requisite in in situ compound formation yet the potential required is lower for etched surfaces and is dependent on the original state of the surface.
Dissert. Abstr.

N78-26943 Brown Univ., Providence, R. I.
THE BOND IONICITY AND STRUCTURAL STABILITY OF SOME AVERAGE VALENCE FIVE MATERIALS STUDIED BY X-RAY PHOTOEMISSION Ph.D. Thesis
Richard Barry Shalvoy 1977 260 p
Avail: Univ. Microfilms Order No. 78-09093

An X-ray photoemission study was performed on some average valence five (5) materials including the Group 5 elements As, Sb, and Bi, and the Group 4 and 6 compounds GeS, GeSe, GeTe, SnS, SnSe, SnTe, PbS, PbSe, and PbTe with the goal of understanding the importance of ionic bonding in stabilizing the structures of these materials. The core electron binding energies, some Auger transition energies, plasmon energies, and the valence band structures of all nine elements and the nine compounds are determined with particular attention given to the chemical shifts of the core electron binding energies. Shifts due to changes in relaxation energies are estimated and found to be small relative to the chemical. The results of an optical reflectivity experiment on the orthorhombic structured materials using near IR radiation are reported. Dissert. Abstr.

N78-26944 North Carolina Univ., Chapel Hill.
SUPERCONDUCTING TRANSITION TEMPERATURES AND RESIDUAL RESISTIVITIES OF HIGHLY DISORDERED LANTHANUM-GOLD FILMS Ph.D. Thesis
Joanne Snare 1977 116 p
Avail: Univ. Microfilms Order No. 78-07166

Superconducting transition temperature and the residual resistivities of the films were determined as a function of gold concentration. The transition temperature decreased with increasing gold concentration, varying from 4.6 K for pure lanthanum films to 1.6 K for La68Au32 films. The residual resistivity increased with increasing gold concentration, varying from 63 microohm-cm for pure lanthanum films to 210 microohm-cm for La68Au32. The disordered films were annealed to room temperature to determine the stability of the disordered phase. The films were also affected by oxidation, which reduced the transition temperature and raised the residual resistance. After subtracting the effects of oxidation, it was determined that disordered films containing less than 26 atomic percent gold crystallized during annealing to room temperature.
Dissert. Abstr.

N78-26945 Stanford Univ., Calif.
INTERATOMIC FORCES IN TETRAHEDRAL SOLIDS Ph.D. Thesis
Ralph John Sokel 1978 88 p
Avail: Univ. Microfilms Order No. 7808843

A linear combination of atomic orbitals model for the electronic structure of tetrahedrally coordinated solids was used to examine the elastic properties of these materials. The model used is one based upon the approximation of neglecting matrix elements of the Hamiltonian between bonding and antibonding states. This approximation is improved by treating the antibonding states with perturbation theory. The extent to which the antibonding states are important is discussed. A force constant model, suggested by the calculations for k = 0 modes is introduced. A particular long-range force is developed from a bond-charge model. This is an exponentially decaying force whose range depends on the band gap and the effective masses of the valence band maximum and the conduction band minimum. Dissert. Abstr.

N78-26946 Lehigh Univ., Bethlehem, Pa.
LUMINESCENCE OF COPPER-EXCHANGED Y-ZEOLITE Ph.D. Thesis
David Hall Strome 1978 148 p
Avail: Univ. Microfilms Order No. 7808079

Y-zeolite exchanged with copper, dehydrated, and reduced in one atmosphere of hydrogen at 210 C for 14 hours, exhibits a bright green (lambda = 530 nm) luminescence. The absorptions feeding the emission were assigned to terms originating from the D-1 free ion levels of the excited state configuration of monovalent copper as split by the C sub 3 v ligand field at the exchanged ion site, and by Jahn-Teller distortions in the unrelaxed excited state. The effects of the co-exchanged ions Ni(2+), CO(2+), and Mn(2+) were investigated. In each case the presence of a second ion caused an acceleration of the Cu+ luminescence decay and a decrease in the relative quantum efficiency, but no changes in the spectral shape of the luminescence bands. The admission of carbon monoxide to a luminescing Cu+-Y sample caused a slow disappearance of the original emission.
Dissert. Abstr.

N78-26947 Louisiana State Univ. and A&M Coll., Baton Rouge.
EXACT PHYSICAL PROPERTIES OF ELECTRON GASES IN UNIFORM MAGNETIC FIELDS AT T = 0 K, PART 1. THE PATH OF A SOUND WAVE IN GENERAL RELATIVITY, PART 2 Ph.D. Thesis
Young Bae Suh 1977 155 p
Avail: Univ. Microfilms Order No. 7807561

Functions were defined and used to obtain the total energies, pressures, Fermi energies, magnetizations, susceptibilities, and singularities of free Schroedinger and Dirac electron gases in uniform magnetic fields of arbitrary strength. The Schroedinger case was extended to the Bloch electrons on the ellipsoidal constant energy surface. The Dirac case was applied to a white dwarf in an external magnetic field. The general path equation of interior sound waves and exterior light waves was derived. The Einstein-Cartan theory of gravitation is used to demonstrate that the sound path deflects towards the stronger gravitational fields and is expected to deflect less in the medium with polarization. Dissert. Abstr.

N78-26948 California Univ., San Diego.
SUPERCONDUCTIVITY AND THE ELECTRON-PHONON INTERACTION IN ALPHA-PHASE ALLOYS OF Cu, Ag AND Au Ph.D. Thesis
Roger Franklin Hoyt 1978 171 p
Avail: Univ. Microfilms Order No. 7808088

The substitutional solid solutions formed by Cu, Ag, and Au with the elements from the right hand side of the periodic table are found to be superconducting. The superconducting transition temperatures are all below 300 mK and depend quite strongly on concentration. Measurements of this concentration dependence allows extrapolations of these data to the superconducting T sub c of the pure elements to be made. Investigations of ternary Au solid solutions confirm that there is a strong dependence of

T sub c on the state of strain in the lattice. The ternary alloys show a different dependence of T sub c on lattice parameter than the binary alloys, but the concentration dependence of the strain energy as calculated from the lattice parameter is able to account for the variation of T sub c. Dissert. Abstr.

N78-26949 Pennsylvania State Univ., University Park.
THE SELF-CONSISTENT PHONON THEORY AND THE CALCULATION OF BRILLOUIN ZONE SUMS, WITH APPLICATION TO POTASSIUM CHLORIDE Ph.D. Thesis
Michael Gordon Duffy 1977 217 p

Effects of anharmonicity on the vibrational modes of KCl are studied by examining the temperature dependent frequency shifts induces in these modes. The best currently available scheme for computing these shifts is the improved self-consistent phonon approximation. The equations for this approximation were extended to non-primitive lattices for crystals whose atoms interact via two-body central forces. Also obtained are expressions for the isothermal elastic constants. Dissert. Abstr.

N78-26950 California Univ., San Diego.
THE LATTICE DYNAMICS OF A QUASI ONE-DIMENSIONAL CONDUCTOR Ph.D. Thesis
Nirjar Vinayak Dandekar 1978 169 p
Avail: Univ. Microfilms Order No. 7808085

The observation of the acoustic phonon spectrum in the organic charge transfer complex TTF-TCNQ established the presence of the Kohn anomaly, in the high temperature phase, in the transverse acoustic mode, and also the absence of such anomaly in the longitudinal mode. A first principle theory of lattice vibrations of a quasi one-dimensional conductor, and attempt to explain the salient features observed in the lattice dynamics of TTF-TCNQ. The effect of the dynamics of the electrons and the holes on the phonon frequency is formulated, in the adiabatic approximation, by using the localized wave functions for the conduction electrons (holes). The results of the calculation show low frequency optic modes interacting with the LA mode. The observed LA mode shows smooth, monotonically rising dispersion curve in the same energy region. Dissert. Abstr.

N78-26951 Pennsylvania State Univ., University Park.
DOMAIN CONTRIBUTIONS TO THE DIELECTRIC RESPONSE IN FERROELECTRIC CRYSTALS Ph.D. Thesis
Terry William Cline 1977 161 p
Avail: Univ. Microfilms Order No. 78-08338

The dielectric behavior along the ferroelectric c-axis of melt grown single crystals of Pb5Ge3O11 and Sr0.5Ba0.5Nb2O6 was studied under weak fields in the thermally depoled and electrically poled, electrically depoled single domain condition. It is shown that the thermally depoled permittivity of both of these simple ferroelectric materials is strongly dispersive. The single domain permittivity is much lower up to piezoelectric resonance. The electrically depoled state is of even lower permittivity and the difference from the single domain value is satisfactorily accounted for by clamping of the piezoelectric response. Dielectric data suggest an unusually high density of 180 deg domain walls in the thermally depoled condition. Dissert. Abstr.

N78-26952 Miami Univ., Fla.
ELECTROMAGNETIC AND MAGNETOELASTIC TRANSMISSION RESONANCE INVESTIGATIONS IN NICKEL Ph.D. Thesis
Jerry William Allen 1977 88 p
Avail: Univ. Microfilms Order No. 7808232

In the experiments a one watt microwave signal at 9.37 GHz excites an input cavity using the sample as a common wall with the output cavity. When a dc magnetic field is applied in the direction perpendicular to the surface of a thin metal sample and thus perpendicular to the incident microwave field, two transmission peaks are found, a known peak at 2.6 kG at 10 to the minus 17th power watts power and a previously undiscovered peak at 8.2 kG at 5 x 10 to the minus 16th power watts. An absorption peak is also found at 8.2 kG. The first is merely microwave propagation through the sample describable by standard analysis. The second peak seems to be describable by magnetoelastic effects. When the applied field is parallel to the sample and perpendicular to the incident microwave field, a previously undiscovered peak at 2.7 kG is detected in transmission. Calculations for all three geometries for both the electromagnetic and magnetoelastic cases are presented. Dissert. Abstr.

N78-26953 Florida State Univ., Tallahassee.
NUCLEAR STRUCTURE STUDIES WITH MUONIC X-RAYS Ph.D. Thesis
Martha Vaughan Hoehn 1977 157 p
Avail: Univ. Microfilms Order No. 7808955

The muonic isomer shift of the 2614-keV gamma transition in Pb-208 was measured as 6.18 + or - 0.28 keV. This result is in disagreement with interpretation of the 3(-) state as a one-phonon octupole vibration. Anomalous transitions in the muonic spectra of Os-188 and Yb-172 were interpreted as nuclear resonances involving the muonic 2p and 3d levels. A sequence of Os nuclei (186, 188, 190, 192) was studied with muonic X-rays. The Barrett radii for the monopole part of the nuclear charge distribution were extracted. Isotope shifts are consistent with previously observed trends for nuclei in this mass region. Electromagnetic moments involving the first and second excited 2(+) states in these nuclei were determined from the muonic data using a model-independent method of analysis. The precise data from the present experiment indicate a deviation from theoretical calculations of the pairing-plus-quadrupole model. Dissert Abstr.

N78-26954*# Maryland Univ., College Park. Dept. of Electrical Engineering.
THE STUDY OF SURFACE ACOUSTIC WAVE CHARGE TRANSFER DEVICE Semiannual Report
N. Papanicolaou and H. C. Lin 13 Jul. 1978 22 p
(Grant NsG-1468)
(NASA-CR-157241) Avail: NTIS HC A02/MF A01 CSCL 20L

A surface acoustic wave-charge transfer device, consisting of an n-type silicon substrate, a thermally grown silicon dioxide layer, and a sputtered film of piezoelectric zinc oxide is proposed as a means of circumventing problems associated with charge-coupled device (CCD) applications in memory, signal processing, and imaging. The proposed device creates traveling longitudinal electric fields in the silicon and replaces the multiphase clocks in CCD's. The traveling electric fields create potential wells which carry along charges stored there. These charges may be injected into the wells by light or by using a p-n junction as in conventional CCD's. A.R.H.

N78-26955# International Business Machines Corp., Hopewell Junction, N. Y. East Fishkill Labs.
DAMAGE PROFILES IN SILICON AND THEIR IMPACT ON DEVICE RELIABILITY Final Report
G. H. Schwuttke and K. H. Yang 1 Apr. 1978 151 p refs
(Contract N00173-76-C-0303; DARPA Order 3231)
(AD-A053195; TR-22.2185) Avail: NTIS HC A08/MF A01 CSCL 20/12

The principle of defect engineering is applied to GaAs substrates to produce epitaxial layers of low crystallographic defect density. Defect engineering is achieved through control of surface stresses in GaAs wafers during high temperature processing. Surface stress control is obtained through Impact Sound Stressing damage introduced on wafer backsides before epitaxial processing. Thus, epitaxial GaAs layers obtained through liquid phase epitaxy contain low dislocation numbers through confinements of threading dislocations to the epitaxial-substrate interface. A detailed analysis of ISS damage in GaAs before and after annealing is also given. Author (GRA)

N78-26956# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
GLOW DISCHARGE OPTICAL SPECTROSCOPY OF MAGNETIC BUBBLE GARNET FILMS M.S. Thesis
Larry D. Crocker Dec. 1977 53 p refs
(AD-A052919; AFIT/GE/EE/77-12) Avail: NTIS HC A04/MF A01 CSCL 20/12

A spectrographic study of several magnetic bubble garnet films was done using the Glow Discharge Optical Spectroscopy technique. Argon and krypton were used to sputter the samples for analysis. Lines of most of the elements in the films were successfully identified, but the apparatus used was not sensitive

enough to detect trace impurities. Equipment and techniques used and the methods of data reduction are explained in detail. Suggestions for improvements to the system are also included. The study demonstrates the feasibility of using the GDOS method for characterization of rare earth substituted garnet films.
Author (GRA)

N78-26957# Sandia Labs., Albuquerque, N. Mex.
RADIATION INDUCED TRANSIENT THERMAL EFFECTS IN 5 MHz QUARTZ RESONATORS
D. R. Koehler, T. J. Young, and R. A. Adams 1977 21 p refs Presented at the Ultrasonics Symp., Phoenix, Ariz., 26 Oct. 1977
(Contract EY-76-C-04-0789)
(SAND-77-1747C; Conf-771064-1) Avail: NTIS HC A02/MF A01

A bulk resonator's response to ionizing radiation is concerned with a number of factors, including: (1) induced photoconductivity in the quartz; (2) changes in the elastic modulus and the Q of the resonator; (3) temperature rise in the quartz from the deposited ionizing radiation; and (4) induced stress gradients in the crystal stemming from non-uniform temperature changes throughout the resonator structure. Heretofore, the factors causing the largest radiation-induced effects have been due to crystal impurities which manifested themselves as frequency and resistance changes. In very high quality quartz which has been swept, frequency variations originating from the temperature factors mentioned are observed. A thermal model of the quartz resonator structure and associated oven led to a transient response description in good agreement with the experimental data. Short-term transient frequency excursions in very pure, swept quartz are primarily determined by thermal phenomena. ERA

N78-26958# Tennessee Univ., Knoxville.
MAGNETOELASTIC ENERGY CALCULATIONS FOR FINITE ELEMENT ANALYSIS OF SUPERCONDUCTORS
J. E. Akin and W. C. T. Stoddart (ORNL) 1977 4 p refs Presented at 7th Symp. on Fusion Res. Project, Knoxville, Tenn., 25 Oct. 1977
(Contract W-7405-eng-26)
(CONF-771029-99) Avail: NTIS HC A02/MF A01

It was shown that the high current density and magnetic flux density associated with superconductors can make the magnetoelastic energy a significant portion of the total energy in a structural system. The present work presents a procedure for evaluating this magnetoelastic energy for use in the finite element analysis of the structural dynamics and stability of the superconductor. A simple, special case of the element matrices is illustrated. ERA

77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

N78-26959 California Univ., Riverside.
THE THERMODYNAMIC PROPERTIES OF THE FOUR-POSITION MODEL WITH LONG RANGE INTERACTIONS Ph.D. Thesis
John Charles Hayward, Jr. 1977 103 p
Avail: Univ. Microfilms Order No. 7808283

A four position model with a two component order parameter (n=2) and attractive 1/r(d=+sigma) (d=1) type transactions for linear chains of N spins is proposed. This model is studied analytically in the mean field limit (sigma yields (-1)), and numerically for N less than or equal to 12 and 0.5 less than or equal to sigma is less than or equal to 1. The Pade approximant and ratio method are used on series extracted from the different N-sequences to estimate the thermodynamic properties of the system. The density of states, average energy, specific heat, long range correlation and the critical exponent gamma show definite dependence on the range sigma. From the extrapolated high temperature susceptibility, the critical exponent gamma is extracted. Possible explanation of the Ising-like behavior (n=1) is discussed along with possible extensions of the model which may be essential to observe the n-dependence of gamma.
Dissert. Abstr.

N78-26960 Cornell Univ., Ithaca, N. Y.
CLASSICAL AND STATISTICAL MECHANICS OF NONLINEAR FIELDS WITH APPLICATIONS IN CONDENSED MATTER PHYSICS Ph.D. Thesis
John Frederick Currie 1977 230 p
Avail: Univ. Microfilms Order No. 78-07778

One-dimensional nonlinear scalar and vector fields are discussed. The soliton-bearing sine-Gordon equation was chosen as a prototype scalar field. For this model a complete and explicit construction for the general solutions was discovered and the ramifications for soliton dynamics were explored. Numerical simulations investigated the effects of an underlying lattice, local defects in model parameters, and imposed external forces on the propagation of solitons. The exact statistical mechanics were calculated and interpreted using nonlinear solutions to the classical equations of motion. Based on formal analyses of the Hamiltonian structure of sine-Gordon theory a phenomenological calculation of the statistical mechanics is achieved which agrees with the results of the exact calculation. Techniques are presented for finding nonlinear vector kink-structures approximately and these techniques were applied to three representative models of condensed matter physics. Dissert. Abstr.

N78-26961# Naval Postgraduate School, Monterey, Calif.
AN EXPERIMENTAL STUDY OF STEAM CONDENSATION ON A SINGLE HORIZONTAL TUBE M.S. Thesis
Derry Thomas Pence Mar. 1978 104 p refs
(AD-A053360; NPS69-78-002) Avail: NTIS HC A06/MF A01 CSCL 13/1

An experimental test facility capable of investigating plain and enhanced horizontal tubes was built. The test facility consists of an electric boiler, test condenser and associated piping for steam, condensate, and cooling water. Performance of the test condenser was checked at a steam pressure of 3 psia with cooling water velocities ranging from 5 to 25 ft/sec. Condensation data was obtained for a single, 0.625 inch outside diameter, 90-10 copper-nickel tube in a simulated tube bundle to determine the overall, inside and outside heat transfer coefficients. The overall heat transfer coefficient was determined directly from experimental data, and the Wilson Plot technique was used to determine the inside and outside heat transfer coefficients. The experimentally obtained values for the inside heat transfer coefficient are within 5 percent of the theoretical values predicted by the Sieder-Tate equation. The experimental values obtained for the outside heat transfer coefficient are within 8 percent of the theoretical values predicted by the Nusselt equation.
Author (GRA)

N78-26962# Colorado School of Mines, Golden. Dept. of Chemical and Petroleum Refining Engineering.
ENTHALPY MEASUREMENT OF COAL-DERIVED LIQUIDS Quarterly Technical Progress Report, Oct. - Dec. 1977
A. J. Kidnay and V. F. Yesavage 15 Jan. 1978 20 p refs
(Contract EX-76-C-01-2035)
(FE-2035-10) Avail: NTIS HC A02/MF A01

Experimental enthalpy measurements were made on a naphtha sample produced by the SRC-I process. A total of 116 enthalpy determinations were made covering the ranges 160 to 670 F and 30 to 900 psia. A comparison of three correlations for enthalpy with the experimental data for a Synthoil distillate was also made. The predicted enthalpies were considerably in error.
ERA

N78-26276# General Motors Research Labs., Warren, Mich.
THE ENTHALPY FLUX LOSS THROUGH A STIRLING CYCLE REGENERATOR WITH THE FLOW RESISTANCE SATISFYING DARCY'S LAW
Robert Hickling *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 2: Stirling Cycle Anal. and Eng. Design Studies Apr. 1978 6 p refs (For availability see N78-26262 17-31)
(GMR-2690-Sect-2.114) Avail: NTIS HC A14/MF A01

N78-26279# General Motors Research Labs., Warren, Mich.
STUDY OF STIRLING ENGINE HEAT SOURCES 1: HEATING SYSTEM ENERGY BALANCE
John C. Steiner *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 2: Stirling Cycle Anal. and Eng. Design Studies Apr. 1978 18 p (For availability see N78-26262 17-31)
(GMR-2690-Sect-2.201) Avail: NTIS HC A14/MF A01

N78-26280# General Motors Research Labs., Warren, Mich.
STUDY OF STIRLING ENGINE HEAT SOURCES 2: OPTIMUM PLAIN TUBE ENGINE HEATER DESIGNS
John C. Steiner *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 2: Stirling Cycle Anal. and Eng. Design Studies Apr. 1978 30 p (For availability see N78-26262 17-31)
(GMR-2690-Sect-2.202) Avail: NTIS HC A14/MF A01

80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

N78-26963# Antioch Coll., Washington, D. C. Social Studies Research Project.
A LONGITUDINAL STUDY OF MAN: A COURSE OF STUDY SUMMARY REPORT Final Report
H. Russell Cort, Jr. and Nancy Peskowitz 30 Dec. 1977 69 p refs 5 Vol.
(Grant NSF SED-72-06289-A04)
(PB-278367/8) Avail: NTIS HC A04/MF A01; HC also available in set of 5 reports HC E16, PB-278366-SET CSCL 05I

A brief description is given of the longitudinal evaluation of the MACOS project (Man, A Course of Study); major outcomes of the evaluation; characteristics of the MACOS and non-MACOS classes and teachers; and concluding remarks. It is felt that: (1) MACOS clearly interested a large number and variety of students; (2) most MACOS teachers liked the program; (3) MACOS was more effective with sixth than fifth graders; (4) MACOS was not systematically advantageous in teaching problem solving, inquiry skills, tolerance for ambiguity, or confidence in problem-solving; (5) MACOS stimulated positive attitudes towards unusual customs although not to people practicing them; (6) it supported a form of pedagogy consistent with its designers' intentions; and (7) social studies in general may tap important issues and evoke strong reactions, at least temporarily. GRA

N78-26964# Antioch Coll., Washington, D. C. Social Studies Research Project.
A LONGITUDINAL STUDY OF MAN: A COURSE OF STUDY. VOLUME 1: SUMMARY, BACKGROUND AND DESIGN Final Report
H. Russell Cort, Jr. and Nancy Peskowitz 30 Dec. 1977 150 p refs 5 Vol.
(Grant NSF SED-72-06289-A04)
(PB-278368/6) Avail: NTIS HC A07/MF A01; HC also available in set of 5 reports HC E16, PB-278366-SET CSCL 05I

Presented are the entire Summary Report and also chapters on purpose and background of the study and design of the study. The only table of contents for the series is in this volume. GRA

N78-26965# Antioch Coll., Washington, D. C. Social Studies Research Project.
A LONGITUDINAL STUDY OF MAN: A COURSE OF STUDY. VOLUME 2: QUANTITATIVE RESULTS Final Report
H. Russell Cort, Jr. and Nancy Peskowitz 30 Dec. 1977 238 p refs 5 Vol.
(Grant NSF SED-72-06289-A04)
(PB-278369/4) Avail: NTIS HC A11/MF A01; HC also available in set of 5 reports HC E16, PB-278366-SET CSCL 05I

The two sections discussed are: quantitative results and relationships between input, process, climate and outcome variables (canonical variate analyses). The quantitative results section is organized into two main parts: (1) analyses of the beginning characteristics of groups; and (2) findings. The first deals with the characteristics of MACOS and non-MACOS groups at the outset. The second presents the results of analyses of groups with respect to pretest, posttest, Follow-up 1 and follow-up 2 outcomes. In most analyses, variables were treated as falling into one of three major groups: inputs (measures of initial characteristics of students, teachers, and classes); processes and classroom climate (measures of activities and attitudes toward the classroom made during the baseline year); and outcomes (posttest and follow-up achievement and attitude variables).GRA

N78-26966# Antioch Coll., Washington, D. C. Social Studies Research Project.
A LONGITUDINAL STUDY OF MAN: A COURSE OF STUDY. VOLUME 3: INTERVIEWS Final Report
H. Russell Cort, Jr. and Nancy Peskowitz 30 Dec. 1977 303 p refs 5 Vol.
(Grant NSF SED-76-06289-A04)
(PB-278370/2) Avail: NTIS HC A14/MF A01; HC also available in set of 5 reports HC E16, PB-278366-SET CSCL 05I

The student and teacher interviews of the evaluation are examined. Development, conduct, and coding of interviews are discussed. Results of the various interviews are presented. GRA

N78-26967# Antioch Coll., Washington, D. C. Social Studies Research Project.
A LONGITUDINAL STUDY OF MAN: A COURSE OF STUDY. VOLUME 4: APPENDICES Final Report
H. Russell Cort, Jr. and Nancy Peskowitz 30 Dec. 1977 211 p refs 5 Vol.
(Grant NSF SED-72-06289-A04)
(PB-278311/0) Avail: NTIS HC A10/MF A01; HC also available in set of 5 reports HC E16, PB-278366-SET CSCL 05I

The following nine appendices are given: (1) instruments, (2) further characteristics of districts in the study, (3) scattergrams of outcome residuals (4) histograms of principal components (PC) distributions, (5) statistical data for class means, (6) brief description of five exemplary or innovative upper elementary programs, (7) agreement of raters in the coding of interviews with students and teachers, (8) survey and (9) survey of districts. GRA

N78-26968# National Field Research Center, Inc., Iowa City, Iowa.
A NATIONAL ENVIRONMENTAL/ENERGY WORKFORCE ASSESSMENT, BUSINESS AND INDUSTRY, PHASE 1 Final Report
Dec. 1977 73 p refs
(Grant EPA-T-900591-01-0)
(PB-277904/9) Avail: NTIS HC A04/MF A01 CSCL 05I

Workforce needs for pollution control and abatement in the United States for the five-year period of 1976 through 1981 were assessed. Fields for pollution control --air, noise, pesticides, potable water, radiation, solid waste, and wastewater -- are analyzed, together with energy-related programs currently accentuated by the national effort to solve energy supply problems. Information and data collected from the private industrial sector in the areas of pollution control and abatement are presented. Included are indications of current workforce levels and career potentials as supplied by numerous industrial respondents. GRA

N78-26969# National Field Research Center, Inc., Iowa City, Iowa.
A NATIONAL ENVIRONMENTAL/ENERGY WORKFORCE ASSESSMENT, NATIONAL LEGISLATION, PHASE 1 Final Report
Dec. 1977 73 p
(Grant EPA-T-900591-01-0)
(PB-277905/6) Avail: NTIS HC A05/MF A01 CSCL 05I
For abstract, see N78-26968.

N78-26970# National Field Research Center, Inc., Iowa City, Iowa.
A NATIONAL ENVIRONMENTAL/ENERGY WORKFORCE ASSESSMENT, NATIONAL ABSTRACT
Dec. 1977 74 p
(Grant EPA-T-900591-01-0)
(PB-277906/4) Avail: NTIS HC A04/MF A01 CSCL 05I
For abstract, see N78-26968.

N78-26971# Oakland Univ., Rochester, Mich. Manpower Development Higher Educational System.
PIPELINE: AN EMPLOYMENT AND TRAINING SIMULATION Progress Report, 1974 - 1978
Jean L. Easterly and David P. Meyer Feb. 1978 37 p refs (Grant DL-31-26-74-05)
(PB-277833/0; DLMA-31-26-74-05; PR-10) Avail: NTIS HC A03/MF A01 CSCL 05I

A simulation game is reported which represents a typical employability program in a simulated society drawing clients from a given pool of unemployed persons, taking them through a three-phase sequence of services, culminating in referral to a simulated job market. Money is needed to survive in the game and this need may be met in several ways analogous to real life. The game requires 20-40 players, takes about an hour to play and is debriefed in an additional hour to an hour and a half. A brief introduction to employability programs, a list of equipment needed, directions for room set-up, game facilitators instructions and debriefing guidelines are provided. GRA

N78-26972# Carnegie-Mellon Univ., Pittsburgh, Pa. Inst. of Processing Research.
PRI PROGRAM Final Report
G. E. Dieter 30 Jun. 1977 125 p
(Grant NSF GI-29728)
(PB-278276/1; PRI-77-178; NSF/RA-770427) Avail: NTIS HC A06/MF A01 CSCL 05I

Extensive experience in solving industrial problems dealing chiefly with automation, chemical processing, design of equipment, materials processing and research, and economic and marketing analysis of technical ventures was achieved using faculty-graduate student teams. The evaluation of the PRI program in terms of educational program, student capabilities, faculty and administration attitudes and industrial sponsor evaluation is described. The evolution of this program into a college-based project research institute is discussed. GRA

81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

N78-26973*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
CRITICAL REVIEW OF AMES LIFE SCIENCE PARTICIPATION IN SPACELAB MISSION DEVELOPMENT TEST 3: THE SMD 3 MANAGEMENT STUDY
Robert Helmreich (Texas Univ., Austin), John Wilhelm (Texas Univ., Austin), Trieve A. Tanner, Joan E. Sieber (Calif. State Univ., Hayward), and Susan Burgenbauch Jun. 1978 84 p refs
(NASA-TM-78494; A-7471) Avail: NTIS HC A05/MF A01 CSCL 05A

A management study was conducted to specify activities and problems encountered during the development of procedures for documentation and crew training on experiments, as well as during the design, integration, and delivery of a life sciences experiment payload to Johnson Space Center for a 7 day simulation of a Spacelab mission. Conclusions and recommendations to project management for current and future Ames' life sciences projects are included. Broader issues relevant to the conduct of future scientific missions under the constraints imposed by the environment of space are also addressed. A.R.H.

N78-26974# Stanford Univ., Calif. Dept. of Operations Research.
CIRCULAR ONES AND CYCLIC STAFFING
John J. Bartholdi, III, James B. Orlin, and H. Donald Ratliff 20 Nov. 1977 27 p refs
(Contracts N00014-75-C-0493; N00014-76-C-0096)
(AD-A053202; SU-TR-31) Avail: NTIS HC A03/MF A01 CSCL 15/5

A large class of cyclic staffing problems, when formulated as (linear) integer programs, possess zero-one constraint matrices for which the ones in each row occur in consecutive components (the first and last components are considered consecutive). Included within this class is the problem of minimizing the linear cost of assigning workers to a multi-period cyclic schedule such that the demand in each period is satisfied, and each person works a shift of a common number of consecutive periods and is idle for the other periods (the first and last periods are considered consecutive). Any problem in this class may be transformed via a change of variables so that the resulting constraint matrix is, after deletion of a distinguished column, the transpose of a node-arc incidence matrix. The problem can then be solved in polynomial time parametrically in the distinguished variable as a sequence of network flow problems. Alternately, the optimal value of the distinguished variable can be found to within integer roundoff as its optimal value in the associated linear program with integer constraints ignored.
Author (GRA)

N78-26975# Massachusetts Inst. of Tech., Cambridge. Operations Research Center.
THE MULTI-PRODUCT PRODUCTION CYCLING PROBLEM: TESTING OF HEURISTICS
Stephen C. Graves Mar. 1978 24 p refs
(Contract N00014-75-C-0556; NR Proj. 347-027)
(AD-A053244; TR-147) Avail: NTIS HC A02/MF A01 CSCL 15/5

The multi-product production cycling problem is concerned with the determination of a production/inventory policy for a single capacitated production facility which is dedicated to producing a family of products. In an earlier paper, heuristic policies were proposed for various versions of the multi-product problem. This paper tests the effectiveness of these heuristics by simulation. It is seen that the proposed heuristic utilizing composite products and the lead-time adjustment, is the most effective of the heuristics considered over the set of test problems for the identical-product problem. Likewise, the composite product heuristic is the best heuristic for the identical-cost problem and the correlated demand problem. Author (GRA)

N78-26976# Office of the Director of Defense Research and Engineering, Washington, D. C.
COMMERCIAL BY DESIGN: PROCEEDINGS OF THE WORKSHOP ON COMMERCIAL COMMODITY ACQUISITION
1978 98 p Proc. held 17-19 Jan. 1978; sponsored in part by NBS
(AD-A052933) Avail: NTIS HC A05/MF A01 CSCL 05/1

These proceedings document the results of the Commercial Commodity Acquisition Program workshop entitled 'Commercial by Design'. The workshop addressed the following topics in buying commercial: User Needs, Market Research, Acquisition Strategy, Logistics Support, and Product Evaluation. Discussion and recommendations resulting from the workshop are provided.
Author (GRA)

N78-26977# Arinc Research Corp., Santa Ana, Calif.
MISSILE-X PROGRAM LOGISTIC ELEMENT MANAGEMENT PLAN NUCLEAR HARDNESS AND SURVIVABILITY INTERFACE LEM
A. N. Winter and A. J. Fremer 15 Aug. 1977 35 p refs
(Contract F04606-76-A-0087)
(AD-A052865; W77-1953-TN05) Avail: NTIS HC A03/MF A01 CSCL 05/1

This document is a Logistic Element Management Plan for the Nuclear Hardness and Survivability Interface element. It has been written to provide the NH and S-LEM with guidance in managing the NH and S Interface element and ensuring the integration of ILS NH and S requirements into the system design process. This plan, and those developed for the other eleven logistic elements, will become supplementary documents to the ILSP GRA

N78-26978# National Technical Information Service, Springfield, Va.
COASTAL ZONE MANAGEMENT AND PLANNING, VOLUME 1. A BIBLIOGRAPHY WITH ABSTRACTS Progress Report, 1964 - 1976
Robena J. Brown Apr. 1978 260 p 2 Vol.
(NTIS/PS-78/0326/5) Avail: NTIS HC $28.00/MF $28.00 CSCL 13B

The planning and management of both natural resources and urban growth in the coastal zone are covered in this bibliography. The topics include management and planning concerning: ecology, water rights, environmental problems, land use, fisheries, recreation, economic development, and shore protection. Government administration and citizen participation studies are included. (This updated bibliography contains 255 abstracts, none of which are new entries to the previous edition.) GRA

N78-26979# National Technical Information Service, Springfield, Va.
COASTAL ZONE MANAGEMENT AND PLANNING, VOLUME 2. A BIBLIOGRAPHY WITH ABSTRACTS Progress Report, 1977 - Jan. 1978
Robena J. Brown Apr. 1978 148 p Supersedes NTIS/PS-77/0265 2 Vol.
(NTIS/PS-78/0327/3; NTIS/PS-77/0265) Avail: NTIS HC $28.00/MF $28.00 CSCL 13B

The planning and management of both natural resources and urban growth in the coastal zone are covered in this bibliography. The topics include management and planning concerning: ecology, water rights, environmental problems, land use, fisheries, recreation, economic development, and shore protection. Government administration and citizen participation studies are included. (This updated bibliography contains 143 abstracts, 96 of which are new entries to the previous edition.) GRA

N78-26980# Denver Univ., Colo. Center for Social Research and Development.
AN ANALYSIS OF THE FEDERAL LABORATORY VALIDATION CONCEPT
Louis F. Cicchinelli and Lawrence Burton Oct. 1977 145 p refs
(Contract NSF C-860)
(PB-277976/7; R-77-01; NSF/RA-770419) Avail: NTIS HC A07/MF A01 CSCL 05A

The experiment was designed to investigate the effectiveness of providing performance validation for new technology from the public sector to overcome some of the barriers to an efficient innovation process by identifying and testing Federal incentives. The incentive tested in the Federal Laboratory Validation Experiment involved the opening of the Federal and accredited private laboratories for the purpose of validating new technological products or processes. Twelve sample technologies were selected for study and are included in the Appendix. GRA

N78-26981# General Accounting Office, Washington, D. C. Federal Personnel and Compensation Div.
FEDERAL EMPLOYEE PERFORMANCE RATING SYSTEMS NEED FUNDAMENTAL CHANGES Report to Congress
3 Mar. 1978 155 p
(PB-277983/2; FPCD-77-80) Avail: NTIS HC A08/MF A01 CSCL 05I

An amendment is proposed to chapter 43 of title 5, formerly the Performance Rating Act of 1950, to delete all statutory requirements for performance summary ratings of outstanding, satisfactory, or unsatisfactory for Federal employees. The Chairman and the heads of Federal agencies should improve the performance rating systems by making more use of the collaborative approach. That is, they should (1) establish systems built around employee participation; (2) develop present work requirements; and (3) review work achievements in the performance evaluation process. GRA

N78-26982# General Accounting Office, Washington, D. C. Program Analysis Div.
FEDERAL REGULATORY PROGRAMS AND ACTIVITIES
16 Mar. 1978 239 p
(PB-278489/0) Avail: NTIS HC A11/MF A01 CSCL 05A

An inventory of Federal regulatory programs and activities by agency and authorizing legislation is presented. Federal agencies with regulatory activity or program responsibilities were identified. Agencies were classified by substantive areas, such as power and energy, and natural resources and environment. Agencies were also classified by type of regulatory activity and degree of regulation. GRA

N78-26983# Northwestern Univ., Evanston, Ill.
IMPROVEMENT OF RESEARCH MANAGEMENT RELATIONSHIPS BETWEEN STATE GOVERNMENTS AND THE HIGHER EDUCATIONAL COMMUNITY Final Report
Charles H. Seibert, David Mintzer, and Arthur T. Schmehling 31 Aug. 1977 431 p refs
(Grant NSF NM-44247)
(PB-277991/6) Avail: NTIS HC A19/MF A01 CSCL 05A

Northwestern's RMI Program seeks suggestions for improvement of administrative relations with State agencies. As a constructive step, the RMI Program has distributed a Directory of individuals to contact within the higher education community to agencies. Task forces, with members from representative Illinois education institutions, were established. GRA

82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information storage and retrieval technology; micrography; and library science.

For computer documentation see *61 Computer Programming and Software*.

N78-26984 Michigan Univ., Ann Arbor.
AN INFORMATION RETRIEVAL SYSTEM BASED ON A COMPUTER MODEL OF LEGAL KNOWLEDGE Ph.D. Thesis
Carole Diane Hafner 1978 235 p
Avail: Univ. Microfilms Order No. 78-07057

The relationship between memory structures and information retrieval processes is explored through the creation and analysis of a computer document retrieval system that uses knowledge of the subject matter of its data base to aid the retrieval process. The system uses knowledge coded in a semantic network to extend the query to include other related terms and expressions. A set of six semantic relations is used to define a semantic network model of legal knowledge in the area of Negotiable Instruments Law. A formal language is developed that allows a user to create complex relational expressions describing situations of interest to lawyers. A data base of 400 cases and statutes is defined, using this language to describe the situations that are discussed in each document. Some logical relationships between sets of expressions are explored in the context of different types of queries, and the realization of these relationships in the retrieval system is described and illustrated. Dissert. Abstr.

N78-26985# California Univ., Livermore. Lawrence Livermore Lab.
REQUIREMENTS FOR THE DESIGN OF A SCIENTIFIC DATA BASE MANAGEMENT SYSTEM
V. E. Hampel and D. R. Ries 30 Sep. 1977 22 p refs Presented at OECD/NEA Working Group on Nucl. Inform., Berkeley, Calif., 5 Oct. 1977 Revised
(Contract W-7405-eng-48)
(UCRL-80171-Rev-1; Conf-771062-5) Avail: NTIS HC A02/MF A01

Probable causes for the absence of a portable generalized data base management system for scientific data at the DOE National Laboratories are discussed. An effective system should work equally efficiently with vectors, matrices, arrays, plex variables, space data and text and be capable of storing and displaying data with the customary scientific notations and attributes in different units of measurement. The user should be able to use the system as a programmable calculator for simple mathematical tasks, and extract and transfer data to model or application program for more difficult calculations. The system should permit common access to a library of interrelated data bases and references tables, as well as expansion to an integrated information system on computer networks with distributed resources. The user should be given a reasonable, English-like command language to start, but should also have the option to create dialects and extensions of the system for personal and programmatic needs. ERA

N78-26986# Capital Systems Group, Rockville, Md.
APPLIED SCIENCE AND RESEARCH APPLICATIONS, RECENT RESEARCH REPORTS, FEBRUARY 1978
Feb. 1978 41 p
(Grant NSF ISP-75-22472)
(PB-278530/1; NSF/RA-780002) Avail: NTIS HC A03/MF A01 CSCL 05B

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N78-26987# National Commission on New Technological Uses of Copyrighted Works, Washington, D. C.
TRANSCRIPT OF NATIONAL COMMISSION ON NEW TECHNOLOGICAL USES OF COPYRIGHTED WORKS MEETING NO. 18
Nov. 1977 175 p Meeting held at Cambridge, Mass., 17-18 Nov. 1977
(PB-278329/8; CONTU-78-0001) Avail: NTIS HC A08/MF A01 CSCL 05B

The first day was a round table discussion on the technologies which affect the present and future development of the collection, retention, organization, and delivery of information. Panel members were Dr. Lee Burchinal (National Science Foundation), Moderator; Ms. Barbara Ankeny (M.I.T. Press); Professor William J. Baumol (Princeton and New York Universities); Professors J.C.R. Licklider and Joseph Weizenbaum (M.I.T.); Mr. John Shoch (Xerox Palo Alto Research Center); Mr. Stuart Mathison (TELENET); and Mr. Charles M. Goldstein (National Library of Medicine). The second day Mr. Richard I. Miller, Vice-President of Harbridge House, Inc., summarized a study sponsored by CONTU: Legal Protection of Computer Software; An Industrial Survey. GRA

N78-26988# King Research, Inc., Rockville, Md.
LIBRARY PHOTOCOPYING IN THE UNITED STATES: WITH IMPLICATIONS FOR THE DEVELOPMENT OF A COPYRIGHT ROYALTY PAYMENT MECHANISM Final Report, Apr. 1976 - Aug. 1977
Donald W. King, R. B. Ladd, Dennis D. McDonald, Patricia M. Dowd-Reisin, and Nancy K. Roderer Oct. 1977 271 p refs Sponsored in part by Natl. Commission on New Technol. Uses of Copyrighted Works, and NBS
(Contract OEC-300-76-0234)
(PB-278300/9) Avail: NTIS HC A12/MF A01 CSCL 05B

A national survey was conducted from a sample of public, academic, special and Federal libraries to determine the annual volume of photocopying undertaken for interlibrary loans, local users, and intrasystem loans. Data are also given for the amount of photocopying that occurs under various hypothetical conditions of eligibility as they might be interpreted in the new copyrighted law and in guidelines for photocopying for interlibrary loans. The report documents the effects of these hypothetical conditions from the perspective of both libraries and publishers. GRA

N78-26989# King Research, Inc., Rockville, Md.
STATISTICAL INDICATORS OF SCIENTIFIC AND TECHNICAL COMMUNICATION (1960-1980), 1977 EDITION
D. W. King, D. D. McDonald, N. K. Roderer, C. G. Schell, C. G. Schueller, and B. L. Wood May 1977 366 p refs
(Contracts NSF DSI-75-06942)
(PB-278279/5) Avail: NTIS HC A16/MF A01 CSCL 05B

Research in developing statistical indicators of scientific and technical communication placed special emphasis on the periodical literature including new estimates of the number of journals and other periodicals, characteristics of journals, journal prices, number of subscribers, type of publishers, and coverage by A&L services. Special analyses are also presented for the value of the journals and for the economics of page charges. GRA

N78-26990# Westat Research, Inc., Rockville, Md. Research Div.
ORGANIZATIONAL FACTORS AFFECTING THE FLOW OF SCIENTIFIC AND TECHNICAL INFORMATION IN INDUSTRIAL R AND D DIVISIONS Final Report
Edwin F. Olson Jan. 1978 186 p refs
(Contract NSF-C-75-12800; Grant NSF SIS-75-12800)
(PB-277761/3) Avail: NTIS HC A09/MF A01 CSCL 05B

Based on an organizational diagnosis of the R&D divisions of three companies, this exploratory study found that the information-seeking behavior of scientists and engineers and their effectiveness in obtaining information are affected by the organization's work structures and processes, by the patterns of interpersonal interactions and organizational climate, and by the rewards and support they receive for taking risks to seek information. For example, the functional organization of an R&D unit can lead to barriers between the information specialists and those who need technical information services. In a company where the climate does not support information-sharing across project or department lines the informal information channels are under utilized. Individuals who perceive it as risky to ask for or provide technical information also believe their work groups are ineffective in getting the information they need. GRA

N78-26991# National Bureau of Standards, Washington, D. C.
DIMENSIONS/NBS, VOLUME 62, NUMBER 2 Monthly Report
Feb. 1978 35 p refs
(PB-278023/7; NBS-DIM-62-2-Vol-62-No-2) Avail: NTIS HC A03/MF A01 CSCL 05B

The table of contents for the current issue is: working under pressure; dynamics of information systems and users; bottle safety now the subject of two voluntary standards; new techniques in the measurement of catalytic activity; defection of magnetic auditory evoked responses; ultraviolet photometer for ozone calibration; materials research symposium; conference on crystal growth; guideline on computer performance management; and users manual for LNG materials and fluids. GRA

N78-26992# National Rural Center, Washington, D. C.
THE NATIONAL RURAL INFORMATION CLEARINGHOUSE: A REPORT ON ITS ESTABLISHMENT, ACTIVITIES AND ACHIEVEMENTS Draft Report, Mar. 1976 - Nov. 1977
1977 83 p
(Grant EDA-99-6-09521-1-2)
(PB-278027/8; EDA-78-053) Avail: NTIS HC A05/MF A01 CSCL 05B

The Clearinghouse is the information arm of the National Rural Center (NRC), a private, non-profit organization which was created to serve the people in rural America by engaging in research, special demonstration projects, outreach activities and information services. The mandate of the Clearinghouse is to get appropriate information to the right people at the right time; information about the full range of economic and human development programs that are needed in rural areas, communities, towns and countries. GRA

N78-26993# Pittsburgh Univ., Pa.
TRAINING MODULES FOR USERS OF SCIENTIFIC AND TECHNICAL INFORMATION SERVICES: A HANDS ON TRAINER FOR ONLINE BIBLIOGRAPHIC RETRIEVAL Final Report, 1 Jul. 1976 - 30 Dec. 1977
Dorothy Elaine Caruso Dec. 1977 146 p
(Grant NSF DS-176-09538)
(PB-277973/4) Avail: NTIS HC A07/MF A01 CSCL 05B

Programmed learning aids in three modes: textual, computer-assisted, and emulations of actual systems (DIALOG and ORBIT) which assess a data base of segments of 60+ commonly used source files are contained in modules designed for users of online bibliographic retrieval systems. Th textual materials can be used as they are, with local or remote access to the emulators or to the target systems; the emulators can be accessed remotely or brought up on any computer system supporting ANSI FORTRAN the computer assisted learning and practice sequences can be

accessed remotely or implemented on a system which maintains a capable lesson designer type language. GRA

83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

N78-26994# Stanford Univ., Calif. Systems Optimization Lab.
THE COMPUTATION OF ECONOMIC EQUILIBRIA BY PATH METHODS
Thomas Elken Oct. 1977 127 p refs
(Contracts N00014-75-C-0267; N00014-75-C-0865)
(AD-A053169; SU-SOL-77-26) Avail: NTIS HC A07/MF A01 CSCL 05/3

An introduction to the economic equilibrium model is given and it is demonstrated that a path method can be used to compute equilibria for pure exchange economies in a nonlinear setting. Next, a model is described for an economy in which the utility functions are piecewise linear and the consumption and production sets are polyhedral. It is shown that an equilibrium for this economy is the solution to a system of bilinear equations subject to certain linear inequality and complementarity constraints. Two approaches are discussed for computing equilibria for such economies. The first is the bilinear complementarity algorithm (BCA) and the second is the homotopy retraction algorithm (HRA). Convergence proofs are given for both methods using the general theory for path methods described above. No conclusion could be drawn as to which algorithm was superior, but both performed well enough that it appears that much larger equilibrium problems also can be solved efficiently by these methods. GRA

84 LAW AND POLITICAL SCIENCE

Includes space law; international law; international cooperation; and patent policy.

No abstracts in this category.

85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

N78-26995*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AN INVERTER/CONTROLLER SUBSYSTEM OPTIMIZED FOR PHOTOVOLTAIC APPLICATIONS
Roy Pickrell, George OSullivan (Abacus Controls, Inc., Somerville, N. J.), and Walter C. Merrill 1978 11 p refs Presented at 13th Photovoltaic Specialists Conf., Washington, D.C., 5-8 Jun. 1978; sponsored by IEEE
(Contract E(49-26)-1022)
(NASA-TM-78903; DOE/NASA/1022-78/31; E-9639) Avail: NTIS HC A02/MF A01 CSCL 13F

Conversion of solar array dc power to ac power stimulated the specification, design, and simulation testing of an inverter/controller subsystem tailored to the photovoltaic power source characteristics. Optimization of the inverter/controller design is discussed as part of an overall photovoltaic power system designed for maximum energy extraction from the solar array. The special design requirements for the inverter/ controller include: a power system controller (PSC) to control continuously the solar array operating point at the maximum power level based on variable solar insolation and cell temperatures; and an inverter designed for high efficiency at rated load and low losses at light loadings to conserve energy. Author

N78-26996*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A CYCLE TIMER FOR TESTING ELECTRIC VEHICLES
Richard F. Soltis 1978 11 p Proposed for presentation at the 5th Intern. Elec. Vehicle Symp., Philadelphia, 2-5 Oct. 1978; sponsored by the Elec. Vehicle Council
(Contract EC-77-A-31-1011)
(NASA-TM-78934; E-9677; DOE/NASA/1011-78/27) Avail: NTIS HC A02/MF A01 CSCL 13F

A cycle timer was developed to assist the driver of an electric vehicle in more accurately following and repeating SAE driving schedules. These schedules require operating an electric vehicle in a selected stop-and-go driving cycle and repeating this cycle pattern until the vehicle ceases to meet the requirements of the cycle. The heart of the system is a programmable read-only memory (PROM) that has the required test profiles permanently recorded on plug-in cards, one card for each different driving schedule. The PROM generates a direct current analog signal that drives a speedometer displayed on one scale of a dual movement meter. The second scale of the dual movement meter displays the actual speed of the vehicle as recorded by the fifth wheel. The vehicle operator controls vehicle speed to match the desired profile speed. The PROM controls the recycle start time as well as the buzzer activation. The cycle programmer is powered by the test vehicle's 12-volt accessory battery, through a 5-volt regulator and a 12-volt dc-to-dc converter. Author

N78-26997*# Ford Motor Co., Dearborn, Mich.
CERAMIC REGENERATOR SYSTEMS DEVELOPMENT PROGRAM Progress Report, 1 Jan. - 31 Mar. 1978
J. A. Cook, C. A. Fucinari, J. N. Lingscheit, C. J. Rahnke, and V. D. Rao May 1978 108 p refs
(Contracts DEN3-8; EC-77-A-31-1040)
(NASA-CR-135430; CONS-0008-3) Avail: NTIS HC A06/MF A01 CSCL 11C

Ceramic regenerator cores are considered that can be used in passenger car gas turbine engines, Stirling engines, and industrial/truck gas turbine engines. Improved materials and design concepts aimed at reducing or eliminating chemical attack were placed on durability tests/in industrial gas turbine engines. A regenerator core made from aluminum silicate shows minimal evidence of chemical attack damage after 7804 hours of engine test at 800 C and another showed little distress after 4983 hours at 982 C. The results obtained in ceramic material screening tests, aerothermodynamic performance tests, stress analysis, cost studies, and material specifications are also included. G.G.

N78-26998# Pacific Northwest Environmental Research Lab., Corvallis, Ore.
ENERGY CONSUMPTION OF ADVANCED WASTEWATER TREATMENT AT ELY, MINNESOTA
Donald J. Hernandez Jan. 1978 30 p refs
(PB-278270/4; EPA-600/7-78-001) Avail: NTIS HC A03/MF A01 CSCL 13B

The use of energy in an advanced sewage treatment plant was studied from the point of view of plant operation, support services, and indirect use. A process by process analysis of plant operation indicates the energy used in the treatment process is minimal when compared to other usages. GRA

N78-26999# Culp/Wesner/Culp, El Dorado Hills, Calif.
TRANSPORT OF SEWAGE SLUDGE Final Report
William F. Ettlich Dec. 1977 98 p refs
(Contract EPA-68-03-2186)
(PB-278195/3; EPA-600/2-77-216) Avail: NTIS HC A05/MF A01 CSCL 13B

The costs of transporting liquid and dewatered sludge by truck, rail, barge, and pipeline were investigated. The data includes the installed cost for each system, sludge processing requirements, fuel consumption, manpower, and other operation and maintenance requirements. Loading, unloading, and sludge handling

facilities construction costs, and operation and maintenance requirements are tabulated separately from the requirements for direct hauling so the data can be applied to a variety of specific applications. Results are related in tabular and graphical presentations to appropriate single haul parameters; cubic yards for dewatered sludge and gallon for liquid sludge. GRA

N78-27000# Missouri Univ., Rolla. Missouri Water Resources Research Center.
EFFECT OF GREASE ON WASTEWATER TREATMENT UNIT PROCESSES Final Report
Shankha K. Banerji Jan. 1978 18 p refs
(Contract DI-14-34-0001-7054)
(PB-278049/2; W78-04492; OWRT-A-100-MO(1)) Avail: NTIS HC A02/MF A01 CSCL 13B

Safe levels of grease in sewage that will not interfere with the various treatment processes are determined. The first phase of the research investigated the effect of various grease levels on raw sewage settlement rate under differing temperature conditions. In many plants the secondary sludge is returned to the primary settling tank for settlement in conjunction with the raw sewage. Therefore, influent grease in raw sewage may also effect the settlement of combined primary and secondary sludges. The second phase evaluated the effects of various grease levels on the settlement rate and thickening of combined primary and secondary sludge. The grease levels studied varied from about 50 to 550 mg/l. GRA

N78-27001# Missouri Univ., Rolla.
LAND DISPOSAL OF CHEMICAL SLUDGE Final Report
John T. Novak and Dennis M. Sievers 30 Jul. 1977 66 p refs
(Contract DI-14-34-0001-6093)
(PB-277989/0; W78-04371; OWRT-B-113-Mo(3)) Avail: NTIS HC A04/MF A01 CSCL 13B

Land disposal of chemical slurries generated from water treatment and power generation was investigated. Tests were conducted using soil columns of varying sizes and sludge was applied at several application rates. Most sludges cause no detrimental effects on soil structural properties. Most sludges were beneficial to soils, raising the pH and making the soils more workable. Only alum sludge was detrimental and only slightly so. Lime sludge from water treatment was an acceptable substitute for agricultural limestone. GRA

N78-27002# Sandia Labs., Albuquerque, N. Mex.
TECHNICAL AND ECONOMIC FACTORS IN THE BENEFICIAL USE OF RADIATION IN MUNICIPAL SLUDGE MANAGEMENT
Nov. 1977 106 p refs Prepared jointly with Battelle Pacific Northwest Labs. and Little (Arthur D.), Inc., Cambridge, Mass.
(Contract EY-76-C-04-0789)
(SAND-77-7029) Avail: NTIS HC A06/MF A01

The role that radiation processing of sewage sludge can play in beneficial recycling in agriculture and animal husbandry is assessed. The study was done by an interdisciplinary team, experienced in technology development and assessment, sanitary engineering, and economic analysis. The team reviewed pertinent literature and developed a case-study approach of major sewage-treatment facilities across the United States. The benefits to be derived and the costs and risks involved in radiation processing of sewage sludge were determined. Two processes were found to be reasonably available to recycle raw sludges. One method is to filter-press and flash-dry activated sludge, and the other is to vacuum-filter, compost, and then irradiate raw, primary, and activated sludges. ERA

N78-27003*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STATE-OF-THE-ART ASSESSMENT OF ELECTRIC AND HYBRID VEHICLES
Jan. 1978 596 p refs
(Contract EX-76-A-31-1011)
(NASA-TM-79509; HCP/M1011-01) Avail: NTIS HC A25/MF A01 CSCL 13F

Data are presented that were obtained from the electric and hybrid vehicles tested, information collected from users of electric vehicles, and data and information on electric and hybrid vehicles obtained on a worldwide basis from manufacturers and available literature. The data given include: (1) information and data base (electric and hybrid vehicle systems descriptions, sources of vehicle data and information, and sources of component data); (2) electric vehicles (theoretical background, electric vehicle track tests, user experience, literature data, and summary of electric vehicle status); (3) electric vehicle components (tires, differentials, transmissions, traction motors, controllers, batteries, battery chargers, and component summary); and (4) hybrid vehicles (types of hybrid vehicles, operating modes, hybrid vehicles components, and hybrid vehicles performance characteristics). ERA

N78-27004# Department of Energy, Washington, D. C. Div. of Transportation Energy Conservation.
THE IMPLEMENTATION OF PUBLIC LAW 94-413. THE ELECTRIC AND HYBRID VEHICLE RESEARCH, AND DEVELOPMENT AND DEMONSTRATION ACT OF 1976
Dec. 1977 78 p refs
(DOE/CS-0002/1) Avail: NTIS HC A05/MF A01

The U.S. Congress enacted Public Law 94-413 to foster and support research and development in electric and hybrid vehicle systems and their component technology; to accelerate commercialization of this technology; to encourage small businesses to participate in the development of these vehicles; to identify potential markets, foster innovative marketing approaches, study the long-term demand, and promote consumer acceptance; identify and help remove institutional, legal, and economic barriers; and ascertain long-term changes in the energy and transportation systems required to facilitate electric and hybrid vehicle use. Vehicle technology and energy storage systems technology are briefly reviewed. Special studies and performance standards are cited. Financial incentives are outlined. Demonstration procedures, administration and management, projections and estimates of progress, and recommendations complete the presentation. ERA

N78-27005# Gordian Associates, Inc., New York.
OVERCOMING INSTITUTIONAL BARRIERS TO SOLID WASTE UTILIZATION AS AN ENERGY SOURCE Final Report
Nov. 1977 284 p refs
(Contracts EM-75-C-01-8403; FEA-CO-04-50172-00)
(HCP/L50172-01) Avail: NTIS HC A13/MF A01

The institutional constraints affecting the demand for the various forms of energy available in municipal solid waste (MSW) such as processed fuel, low-quality pyrolysis gas, and steam were investigated with emphasis on possible barriers to participation by investor-owned utilities. Evaluations included process technology (excepting pyrolysis oil), product characteristics, marketability, price, environmental impacts, and such institutional issues as regulatory constraints and utility attitudes toward risk-sharing in projects to recovery energy from waste. Financial and operating risks in MSW-energy recovery are caused by inflation, the lag in rate relief, high interest rates, lack of sufficient investment capital, reliance on fuel adjustment clauses, and the likelihood that MSW-energy investment costs will not be allowed in a utility rate base. Technologies for recovering energy from waste are developing rapidly, however, under any current technology, the cost to recover energy remains greater than the price the recovered energy can command in the marketplace. ERA

N78-27006# Gordian Associates, Inc., New York.
OVERCOMING INSTITUTIONAL BARRIERS TO SOLID WASTE UTILIZATION AS AN ENERGY SOURCE: EXECUTIVE SUMMARY
Nov. 1977 284 p refs
(Contracts EM-75-C-01-8403; FEA-CO-04-50172-00)
(HCP/L50172-02) Avail: NTIS HC A02/MF A01
For abstract, see N78-27005.

N78-27007# Colorado State Univ., Fort Collins. Dept. of Civil and Environmental Engineering.
ACHIEVING URBAN WATER CONSERVATION. PART 1: A HANDBOOK
J. Ernest Flack, Wade P. Weakley, and Duane W. Hill Sep. 1977 225 p refs

(Contracts DI-14-34-0001-6006; DI-14-34-0001-7011; Contract DI-14-34-0001-7012)
(PB-278174/8; OWRT-A-030-COLO(3)-Pt-1; W78-04702) Avail: NTIS HC A10/MF A01 CSCL 13B

The feasibility of using various water conservation measures to reduce urban water demand is studied. Focusing on residential water use, ten conservation techniques were found to be relevant. Structural means such as meters, recycle systems, water saving devices, and flow and pressure reducers were evaluated. System and household leakage and water use restrictions were among the operations means investigated. Codes, public education, pricing, and horticultural changes were the social and economic means studied. Water demand reductions of up to 35 to 40 percent were possible using combinations of these water conservation methods. A procedure for determining a technically feasible program of conservation acceptable to water users was developed. GRA

N78-27008# Colorado State Univ., Fort Collins. Dept. of Political Science.
ACHIEVING URBAN WATER CONSERVATION. PART 2: TESTING COMMUNITY ACCEPTANCE
Robert W. Snodgrass and Duane W. Hill Sep. 1977 219 p refs
(Contracts DI-14-34-0001-6006; DI-14-34-0001-7011; Contract DI-14-34-0001-7012)
(PB-278189/6; OWRT-A-030-COLO(3)-Pt-2) Avail: NTIS HC A10/MF A01 CSCL 13B

The usefulness of survey research in delineating viable water conservation programs is demonstrated. The communities of Lafayette and Louisville, Colorado were used to define socially and politically feasible water conservation policies. Policies with the highest feasibility for acceptance were legal restrictions on water use and restrictions on growth and development. The next most feasible were horticultural techniques and economic solutions. Reuse for agricultural purposes also appeared to have some political feasibility. GRA

N78-27009# Battelle Columbus Labs., Ohio.
AN AGENDA FOR TECHNOLOGY ASSESSMENT IN THE MATERIALS FIELD. VOLUME 1: PRINCIPAL FINDINGS
Alexander Christakis, Samuel Globe, Kazuhiko Kawamura, and Doreen F. McGirr 24 Mar. 1978 66 p refs 2 Vol.
(Grant NSF ERS-77-17735)
(PB-278639/0) Avail: NTIS HC A04/MF A01 CSCL 05A

The views of materials scientists and materials technologies were synthesized to produce a forecast of materials technologies for the ensuing two decades. From these technologies a list of 21 candidate subjects, which are proposed topics for technology assessment, was developed. The ratings of the candidates subjects were treated statistically to rank them as to urgency. From the rankings as to urgency, the five topics selected as meriting highest priority for full technology assessment are biodegradable plastics; conversion of coal to cleaner fuels; electric power generation and transmission; materials for nuclear systems; and mining ocean nodules. GRA

N78-27010# Battelle Columbus Labs., Ohio.
AN AGENDA FOR TECHNOLOGY ASSESSMENT IN THE MATERIALS FIELD. VOLUME 2: APPENDICES
Alexander Christakis, Samuel Globe, Kazuhiko Kawamura, and Doreen F. McGirr 24 Mar. 1978 178 p 2 Vol.
(Grant NSF ERS-77-17735)
(PB-278640/8) Avail: NTIS HC A09/MF A01 CSCL 05A
For abstract, see N78-27009.

N78-27011# California Univ., Berkeley.
THE DIFFUSION OF TECHNOLOGICAL INNOVATIONS AMONG PRIVATELY-OWNED ELECTRIC UTILITIES, 1950-1975 Final Report, Apr. 1975 - Jul. 1976
Robert D. Stoner and Stephan C. Peck May 1977 163 p refs
(Grant NSF PRA-75-16422)
(PB-277370/3; NSF/PRA-7516422/1/8) Avail: NTIS HC A08/MF A01 CSCL 13B

The determinants of diffusion of twenty innovations widely adopted by privately-owned electric utilities from 1950-1975 are studied. The primary data source consists of the responses to a questionnaire sent to 117 class A and B electric utilities. An econometric model is developed to explain differences among utilities in their date of adoption of a given innovation and to determine the extent to which economic and regulatory structural factors influence technological innovativeness. The study findings include: (1) system size has a positive influence on utility innovativeness for almost all innovations, (2) there is no correlation between presence or absence of state regulation and delays in adoption, (3) there is fairly strong evidence that the regulatory lag has an important effect on innovative performance, (4) there is only weak support for a dynamic variant of the Averch-Johnson hypothesis, and (5) tests reveal no significant relationship between any of the variables measuring competitive pressure and utility performance. GRA

N78-27012# California Univ., Berkeley.
THE DIFFUSION OF TECHNOLOGICAL INNOVATIONS AMONG PRIVATELY-OWNED ELECTRIC UTILITIES, 1950-1975, REPORT SUMMARY Final Report
Robert D. Stoner and Stephan C. Peck May 1977 9 p
(Grant NSF PRA-75-16422)
(PB-277371/1; NSF/PRA-7516422/2/8) Avail: NTIS HC A02/MF A01 CSCL 13B
For abstract, see N78-27011.

N78-27013# Cornell Univ., Ithaca, N. Y. Center for Environmental Research.
EFFECT OF SPRAY IRRIGATION OF MUNICIPAL WASTEWATER ON SOIL INVERTEBRATE POPULATIONS AND THE POTENTIAL INFLUENCE ON PHYSICAL FACTORS OF SOIL
Daniel L. Dindal (State Univ. of N.Y., Syracuse), Jean-Pierre Moreau (State Univ. of N.Y., Syracuse), and Linda Theoret (State Univ. of N.Y., Syracuse) Dec. 1977 28 p refs Submitted for publication
(Contract DI-14-31-0001-5130; OWRT Proj. B-048-NY(1))
(PB-278355/3; W78-04818) Avail: NTIS HC A03/MF A01 CSCL 13B

Soil invertebrate samples were collected for three years from four effluent treated and untreated sites. In general, the species diversity and populations of most soil microarthropods decreased on irrigated sites. This group of soil organisms were comprised of fungivores such as collembolans and oribatid mites, predators and fungivores represented by the prostigmatid mites and predaceous mesostigmatid mites. One taxon of mites, the fungivorous astigmatids, remained unchanged by treatment. Total numbers and biomass of earthworms increased with treatment. Earthworms on treated sites had no effect on soil bulk density changes, whereas, a direct relationship exists between worm biomass and soil porosity. Although there was no gross trace metal uptake by earthworms and no heavy metal toxicity occurring as a result of irrigation, different earthworm types and life stages accumulate Cu, Zn, and Cd in species specific concentrations. GRA

N78-27014# Hickok (Eugene A.) and Associates, Wayzata, Minn.
URBAN RUNOFF TREATMENT METHODS. VOLUME 1: NON-STRUCTURAL WETLANDS TREATMENT Final Report, 1974-1976
Eugene A. Hickok, Marcus C. Hannaman, and Norman C. Wenck Dec. 1977 134 p refs Prepared for Minnehaha Creek Watershed District, Wayzata, Minn.
(Grant EPA-S-802535)
(PB-278172/2; EPA-600/2-77-217-Vol-1) Avail: NTIS HC A07/MF A01 CSCL 13B

A major concern of the Minnehaha Creek Watershed District, a natural watershed basin encompassing the area that drains into the Lake Minnetonka - Minnehaha Creek system, near Wayzata, Minnesota, is the water quality of its lakes. A significant impact on lake waters is known to be caused by stormwater runoff; providing control and treatment methods from this pollution source is a large and complex problem. The methods developed by this project may be implemented as an urban stormwater runoff control practice in many of the urban centers of the country that have unused adjacent wetlands. This project has demonstrated the treatability and effectiveness of nonstructural methods to improve the quality of stormwater runoff from urban areas using natural wetlands. GRA

N78-27015# Wisconsin Univ., Madison. Water Resource Center.
DECISION STRUCTURE FOR ASSESSMENT OF THE ECONOMIC IMPACT OF WATER QUALITY STRATEGIES IN AN INDUSTRIAL WATERSHED
Craig E. Stanley and Rodney A. Erickson 1977 178 p refs (Contract DI-14-34-0001-6133; OWRT Proj. B-095-WIS(1)) (PB-278156/5; WIS-WRC-77-07; W78-04701) Avail: NTIS HC A09/MF A01 CSCL 13B

A decision structure that traces the impact of water quality decisions through to the economic effect on an industrial watershed and its contained metropolitan economic system is reported. The basic design and some of the results of initial testing of the model are described. Residual management models for environmental analysis are reviewed with particular attention given to industrial residuals generation and the impacts of pollution abatement strategies. The Milwaukee metropolitan study region is described, water quality monitoring efforts discussed, and major polluting industries are identified. Treatment costs for plants and industries are derived based on present municipal treatment costs and prospective marginal costs municipal treatment. A linear programming model is then applied to the beer producing industry to determine the likely response to abatement costs incurred at current operating levels if effluent restrictions are met. At the macroeconomic level, a 96-equation econometric model of the Milwaukee area (MEM), providing forecast of key variables through 1985, was designed, constructed, and tested. GRA

N78-27016# Virginia Polytechnic Inst. and State Univ., Blacksburg. Virginia Water Resources Research Center.
WASTEWATER USER CHARGES AND INDUSTRIAL COST RECOVERY: GUIDELINES AND EXAMPLES
Peter M. Ashton (Dept. of Fisheries and Environment, Ottawa, Ontario) and William R. Walker Feb. 1978 74 p refs Sponsored by Virginia State Water Control Board.
(PB-277703/5; VPI-VWRRC-BULL-112; W78-04364) Avail: NTIS HC A04/MF A01 CSCL 13B

Municipal applications for Federal grants to construct wastewater treatment works require approval by the Environmental Protection Agency. Adoption of a system of user charges and industrial cost recovery procedures are two of the prime requisites in successful application. These systems must be designed to ensure that all users of federally financed treatment works share in both the capital and the operation and maintenance costs of the facility in a manner proportionate to the extent of their use. This study offers guidelines which, if followed, will enhance favorable review of a grant application by the EPA. It also presents industrial cost recovery procedures and user charge systems that were developed with the goals of providing equity of charge assessment among users and user classes, conformity with prevailing EPA rules and regulations, and simplicity from the viewpoint of those local officials administratively responsible for systems implementation. GRA

N78-27017# Hawaii Univ., Honolulu. Water Resources Research Center.
WELL INJECTION INTO A TWO-PHASE FLOW FIELD: A HELE-SHAW MODEL INVESTIGATION Project Completion Report, 1 Jul. 1975 - 31 Dec. 1976
John A. Williams May 1977 44 p refs
(Contract DI-14-34-0001-6012; OWRT Proj. B-043-HI(2)) (PB-278197/9; TR-108; W78-04709) Avail: NTIS HC A03/MF A01 CSCL 13B

A Hele-Shaw model was employed in conducting preliminary studies of waste water injection into a fresh-saline water system. Three different field conditions were simulated: injection under static conditions, injection into an ambient flow field without a fresh-saline water interface, and injection into an ambient flow field with a fresh-saline water interface. Both single and double-well injections were studied for the latter case of injection in the presence of an interface. The general behavior of the injected-ambient flow field as observed in the two-dimensional Hele-Shaw model is consistent with that observed in a three-dimensional sand-filled, hydraulic model. GRA

88 SPACE SCIENCES (GENERAL)

No abstracts in this category.

89 ASTRONOMY

Includes radio and gamma-ray astronomy; celestial mechanics; and astrometry.

N78-27018 Texas Univ. at Austin.
THE STRUCTURE AND APPEARANCE OF WINDS FROM SUPERCRITICAL ACCRETION DISKS Ph.D. Thesis
David Lawrence Meier 1977 184 p
Avail: Univ. Microfilms Order No. 7807347

Supercritical disk accretion was studied from the standpoint of vertical structure and observational appearance of the disk. Both the vertical and radial disk structure equations were derived from the steady-state fluid equations with viscosity and radiation transport included. The vertical equations with outward flow of the wind were then solved with the Henyey technique. It is found that the transition from subcritical to supercritical disk accretion was accompanied by the establishment of a very extended envelope with a high mass-loss rate. A tendency toward dynamical instability is found for disks with small critical radii at all times during supercritical accretion. All disks appeared to be dynamically unstable for a brief period when transition from subcritical to supercritical accretion took place. Dissert. Abstr.

N78-27019 New Mexico Univ., Albuquerque.
CONVECTION IN PULSATING STARS Ph.D. Thesis
Michael John Robert Costello 1977 117 p
Avail: Univ. Microfilms Order No. 78-09449

Stellar models using mixing length convection in a linear calculation show a red edge to the instability strip. The models are of a 6 solar mass, 1 x 10 to the 37th power ergs/sec luminosity, King 4A composition, cepheid variable star, for various values of effective temperature, Te, and mixing length parameter, alpha. Results were obtained with an assumed instantaneous adjustment of the convective flux to changes in the local stellar conditions. Results show the first overtone mode blue and red edges occur at higher Te than the corresponding fundamental mode edges, and that in the center of the strip there is a region where both fundamental and first overtone modes are unstable to pulsation. Dissert. Abstr.

N78-27020* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
UPPER LIMITS ON THE CYCLOTRON LINES FROM HER X-1 AS OBSERVED WITH OSO-8
B. R. Dennis, G. S. Maurer, E. P. Cutler (Comtech, Lanham, Md.), C. J. Crannell, J. F. Dolan, K. J. Frost, and L. E. Orwig Jun. 1978 19 p refs Presented at Symp. on Gamma Ray Spectroscopy in Astrophysics, Greenbelt, Md., 28-29 Apr. 1978 Submitted for publication
(Grant NsG-5066)
(NASA-TM-79559) Avail: Issuing Activity CSCL 03A

Observations of Her X-1 were obtained during its ON-state in September, 1977, with the high-energy X-ray detector on board OSO-8. Upper limits on the line fluxes at 60 and 135 keV based on these observations are above, and hence consistent with, the positive results reported by Trumper et al. from a balloon flight during the same time interval. A detailed analysis of the time-variable background spectrum suggests that the line emission, especially in the time-averaged spectrum of Her X-1 previously reported by other workers at 25, 60, and 135 keV, is due to instrumental effects. The spectrum obtained with OSO-8 in September, 1977, is considerably steeper than that observed in pre-1976 balloon flights. These results are consistent with the results obtained by Trumper showing a decrease in the effective temperature of Her X-1 between May, 1976, and September, 1977. Author

N78-27021# Academy of Sciences (USSR), Moscow. Inst. of Space Research.
INFINITELY BUILT-UP SPACE RADIO TELESCOPE
V. I. Buyakas, Y. I. Danilov, G. A. Dolgopolov, K. P. Feoktistov, L. A. Gorshkov, A. S. Gvamichava, N. S. Kardashev, V. V. Klimashin, V. I. Komarov, N. P. Melnikov et al 1977 55 p refs
(PR-373) Avail: NTIS HC A04/MF A01

The development and application of spaceborne radio telescopes are reviewed and basic astrophysical problems and radio engineering characteristics relating to detection of extraterrestrial civilizations, detection of stars, planets, and holographs of the increase are outlined. The design of space radio telescopes is discussed together with the injection into orbit. Possibilities of realization of the project are also considered. ESA

90 ASTROPHYSICS

Includes cosmology; and interstellar and interplanetary gases and dust.

N78-27022 Cornell Univ., Ithaca, N. Y.
HYDRODYNAMIC STUDIES IN ASTROPHYSICS: 1. RELATIVISTIC EXPANDING NONTHERMAL RADIO SOURCES; 2. OPTICALLY THICK ACCRETION NEAR THE EDDINGTON LIMIT Ph.D. Thesis
Peter A. J. Vitello 1977 208 p
Avail: Univ. Microfilms Order No. 78-07770

For the radio source models, a treatment of the free expansion into vacuum by a relativistic plasma with an embedded magnetic field is first presented. Both a linear and a spherical geometry are considered. The general features of relativistic free expansion are discussed and compared with those of nonrelativistic free expansion. Nonthermal radio source models are presented using the results of the hydrodynamical solutions for free expansion. Both relativistically and nonrelativistically expanding sources are considered. Steady, spherically symmetric accretion onto a compact object near the Eddington limiting luminosity is also considered for an optically thick, ionized hydrogen plasma. Solutions assuming LTE are treated in detail, with non-LTE flows being briefly discussed. An analysis of convection and Rayleigh-Taylor instabilities are also given. Dissert. Abstr.

N78-27023 Texas Univ. at Austin.
EINSTEIN-MAXWELL FIELDS OF THE KERR-SCHILD AND GENERALIZED KERR-SCHILD CLASS Ph.D. Thesis
Steven Jay Pickrel 1977 98 p
Avail: Univ. Microfilms Order No. 78-07363

Vacuum gravitational field equations were derived for the class of metrics conformally related to Kerr-Schild metrics with geodesic null rays. It was found that all such metrics are necessarily algebraically special. A partial integration of the vacuum field equations was achieved by imposing restrictions on the conformal factor. A new class of algebraically special Einstein-Maxwell spacetimes was discovered by imposing a new assumption on the electrovac field equations. A special member of the class is a new twisting, axially symmetric one parameter generalization of the Reissner-Nordstrom solution. A coordinate transformation was constructed which relates the physically interesting special solution to the field equations derived by Lind. Dissert. Abstr.

N78-27024 Texas Univ. at Austin.
NEW CONSTRAINTS ON THE COMPOSITION OF INTERSTELLAR GRAINS FROM OBSERVATIONS OF EXTINCTION AND POLARIZATION Ph.D. Thesis
Robert Scott McMillan 1977 289 p
Avail: Univ. Microfilms Order No. 78-07346

Observations of interstellar extinction and polarization at optical and near-infrared wavelengths are used to place an upper limit on the optical absorptivity of interstellar grains, to rule out some previously proposed grain materials, and to study the detectability of grain growth. The physical significance of commonly-used color excess ratios is discussed, and recommendations are made for future observations. Dissert. Abstr.

N78-27025 Maryland Univ., College Park.
TITANIUM OXIDE IN COOL STELLAR ATMOSPHERES Ph.D. Thesis
Denise Ann Lengyel-Frey 1977 172 p
Avail: Univ. Microfilms Order No. 78-08194

The titanium isotopic abundance ratios for two M giants, alpha Cet (M2 3) and Beta and (M0 3), were determined through an analysis of titanium oxide absorption features in these stars in the 6800 A region. Synthetic stellar spectra, computed using several different isotopic mixtures, were compared to high dispersion (3 A/mm) coude spectra of the stars. The following fractional abundances were considered: (1) 100% Ti-48; (2) Ti-46; Ti-47; Ti-48; Ti-49; Ti-50 = 0.078; 0.734; 0.055; 0.054; (terrestrial and solar mixture); (3) 0.10; 0.10; 0.55; 0.10; 0.15. Mixture (2) the solar mixture, was found to provide the best fit to both stars. TiO opacity distribution functions were computed and were used in the model atmospheres program MARCS to determine the effect of TiO opacities on the temperature structure of atmospheres of cool giants. The heating and cooling effects of opacities as a function of their frequency and depth distributions were studied. An explanation of these effects is given. Dissert. Abstr.

N78-27026 Stanford Univ., Calif.
A STUDY OF LARGE-SCALE SOLAR MAGNETIC AND VELOCITY FIELDS Ph.D. Thesis
Thomas Lee Duvall, Jr. 1978 117 p
Avail: Univ. Microfilms Order No. 7808782

Full-disk maps of the solar magnetic field were made daily over a one year period (weather permitting) and used to derive the average poloidal and toroidal components of the magnetospheric field near solar minimum as a function of latitude. The toroidal field was then used to derive the electric current crossing the photosphere. Line shift measurements were obtained and used to study the solar rotation, the limb effect on the disk, and the possibility of a mean meridional circulation in the photosphere. The equatorial rotation rate is found to have a value of 2.81 micron rad/sec. An analysis of the equatorial velocity residuals shows that the line profile is redshifted at the center of the disk relative to a position 0.6 solar radii from the center by 30 m/s. By comparing the equatorial velocity residuals with meridional scans a signal is found consistent with a meridional flow towards the poles of 20 m/s between latitudes 10 - 50 deg. Dissert. Abstr.

N78-27027 Cornell Univ., Ithaca, N. Y.
TOPICS IN THE PHYSICS OF INTERSTELLAR GRAINS Ph.D. Thesis
Bruce T. Draine 1978 190 p
Avail: Univ. Microfilms Order No. 7809473

Photoelectric emission from interstellar grains and the role of grains in the thermal balance of interstellar neutral atomic hydrogen are discussed. The theory of time-dependent homogeneous nucleation in a supersaturated cooling gas was applied to determine an analytical method for approximating the critical supersaturation, mean final cluster size, and relative dispersion in final cluster sizes. Sputtering rates for interstellar grains are predicted and the efficacy of sputtering as a grain destruction mechanism was assessed. An exact result is given for the sputtering rate for a charged sphere moving through a thermal plasma. A thermal spike model for sputtering is considered, and thermal effects in small targets are discussed. Yields are estimated for H, He, and O sputtering of graphite, MgSiO3, Fe, H2O, and CH4. Dissert. Abstr.

N78-27028 Cornell Univ., Ithaca, N. Y.
STUDIES OF INTERSTELLAR NEUTRAL HYDROGEN AT TWENTY-ONE CENTIMETER WAVELENGTH Ph.D. Thesis
John Miller Dickey 1977 198 p
Avail: Univ. Microfilms Order No. 7807779

The interstellar medium in the directions of twenty seven extragalactic sources at high and intermediate galactic latitudes (absolute value of b(2) greater than 5 degrees) at 21 cm wavelength with the upgraded Arecibo telescope (HPBW = 3.2 feet, Gain approximately 6 K/Jy) were calculated. Each region was observed for approximately two hours to detect optical depths as low as 0.01 in most cases. The data allow the derivation of optical depths, harmonic mean spin temperatures, and column densities for the neutral hydrogen as a function of velocity in the range -200 less than v less than 200 km/s (LSR) with

resolution as fine as 0.25 km/s. Spin temperatures as high as 1000 K are evident, with a significant fraction of the neutral hydrogen still hotter. The cooler material is distributed over all temperatures from 30 K to at least 800 K. At latitudes below absolute value b(2) less than 20 degrees values for the harmonic mean temperature T sub spin in the range 100 K to 300 K are most common. Sixty-six separate absortion features, tentatively associated with neutral hydrogen clouds, with central temperatures ranging from 30 to 500 K were detected. Dissert. Abstr.

N78-27029 Stanford Univ., Calif.
RADIATIVE TRANSFER IN DUSTY NEBULAE Ph.D. Thesis
Roger Alan Dana 1978 139 p
Avail: Univ. Microfilms Order No. 7808776

Two problems of radiative transfer in dusty nebulae are addressed; the effect of dust scattering on observable optical and infrared parameters and the accuracy of approximate solutions. The equation of radiative transfer in a static and homogeneous, but not necessarily uniform, distribution of gas and dust around a central empty core with a point source of energy at its center is solved. The dust properties were characterized by a phenomenological extinction cross section, albedo and parameters describing the anisotropy of dust scattering. For ultraviolet photons the ionization equilibrium equations for the gas were simultaneously solved, and for infrared photons a self-consistent dust temperature was calculated. Ray tracing is used to solve for the angular dependence of the intensity. Dissert. Abstr.

N78-27030 Maryland Univ., College Park.
THE INTERACTION OF SUPERNOVA REMNANTS AND INTERSTELLAR CLOUDS CONTAINING CARBON MONOXIDE Ph.D. Thesis
Robert Huston Cornett 1977 227 p
Avail: Univ. Microfilms Order No. 7808190

Observations in 2.6 CO emission were made with an 11-meter, a 5-meter, and a - 1.2-meter telescope to study the interactions of supernova remnants (SNRs) with dense CO containing clouds. Of the 23 SNRs searched for such interactions, 5 are interacting, 13 are probable, and 5 cases are uncertain. In the interacting cases, the velocity profile of the CO cloud changes systematically at the projected edge of the SNR. In the four cases (Tycho's SNR, IC443, W28, and W41) in which the CO cloud lies primarily to one side of the SNR, the change is in the form of either a shift or an apparent broadening of the CO line just outside the SNR's boundary. In W44, the CO cloud's velocity feature is broadest near the SNR's projected center, and is systematically narrower toward the edges of the cloud. The column density of the cloud is largest at a position just outside the edge.
Dissert. Abstr.

N78-27031 Texas Univ. at Austin.
CHLORINE ABUNDANCES IN EARLY B STARS Ph.D. Thesis
Frederick Carlton Bruhweiler 1977 174 p
Avail: Univ. Microfilms Order No. 7807271

Far-ultraviolet spectral scans were obtained of wavelength regions (970-1075A) corresponding to the resonance transitions of Cl 2, 3, and 4 using the Princeton spectrometer aboard the OAO-3 satellite. An abundance study of chlorine, incorporating non-LTE calculations and spectral synthesis, was performed for the three stars upsilon Ori (BOV), chi sup 1 CMa (BO.5IV), and gamma Peg (B21V). The non LTE calculations show that effects of non-LTE are unimportant in Cl 3 and Cl 4. But in Cl 2, observable departures from LTE are predicted and confirmed by the observations. Results are somewhat lower than those suggested by other abundance analyses of B stars based upon observed weak transitions with theoretical gf values.
Dissert. Abstr.

N78-27032 Brandeis Univ., Waltham, Mass.
THE EFFECTS OF ION AND ELECTRON SCREENING OF THERMONUCLEAR REACTION RATES Ph.D. Thesis
Leslie Ray Brady, Jr. 1977 237 p
Avail: Univ. Microfilms Order No. 7808627

The effects of screening by ions and electrons on thermonuclear reaction rates in stellar plasmas are considered. The enhancement of the reaction rate ranges from negligible to extremely large (on the order of 10 to the 26th power or greater). The potential about a given reacting nucleus is determined. The screened reaction rate is found by the saddle-point method. An expression for the screening factor for resonant reaction rates is derived. A different and relatively simple approach is used to find the barrier penetration from the action integral in two approximations: a modified Coulomb potential and a constant-shift potential. Screening factors are calculated for carbon burning at T sub 6 = 100 and T sub 6 = 400 for a wide range of densities and also for several examples in later stellar evolution. The increase in reaction rates for carbon burning indicates that carbon ignition may occur at lower densities than previously thought and may effect the density at which a supernova shock may occur. Dissert. Abstr.

N78-27033*# Iowa Univ., Iowa City. Dept. of Physics and Astronomy.
RESEARCH IN SPACE PHYSICS AT THE UNIVERSITY OF IOWA Annual Report, 1977
J. A. VanAllen Jul. 1978 63 p refs
(Grant NGL-16-001-002)
(NASA-CR-157235) Avail: NTIS HC A04/MF A01 CSCL 03B

Specific fields of current investigation by satellite observation and ground-based radio-astronomical and optical techniques are discussed. Topics include: aspects of energetic particles trapped in the earth's magnetic field and transiently present in the outer magnetosphere and the solar, interplanetary, and terrestrial phenomena associated with them; plasma flows in the magnetosphere and the ionospheric effects of particle precipitation, with corresponding studies of the magnetosphere of Jupiter, Saturn, and possibly Uranus; the origin and propagation of very low frequency radio waves in the earth's magnetosphere and ionosphere; solar particle emissions and their interplanetary propagation and acceleration; solar modulation and the heliocentric radial dependence of the intensity of galactic cosmic rays; radio frequency emissions from the quintescent and flaring sun; shock waves in the interplanetary medium; radio emissions from Jupiter; and radio astronomy of pulsars, flare stars, and other stellar sources. A.R.H.

N78-27034*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GAMMA-RAY ASTROPHYSICS: A NEW LOOK AT THE UNIVERSE
Jacob Trombka, Carl Fichtel, Jonathan Grindlay, and Robert Hofstadter Mar. 1978 32 p refs Submitted for publication
(NASA-TM-78103) Avail: NTIS HC A03/MF A01 CSCL 03B

Gamma-ray astronomy which includes the spectral region from above approximately 100 keV to greater than or equal to 1000 GeV permits investigation of the most energetic photons originating in our galaxy and beyond and provides the most direct means of studying the largest transfers of energy occurring in astrophysical processes. Of all the electromagnetic spectrum, high-energy gamma-ray astronomy measures most directly the presence and dynamic effects of the energetic charged cosmic ray particles, element synthesis, and particle acceleration. Further, gamma rays suffer negligible absorption or scatterings as they travel in straight paths; hence, they may survive billions of years and still reveal their source. The high energy processes in stellar objects (including our Sun), the dynamics of the cosmic-ray gas, the formation of clouds and nebulae, galactic evolution and even certain aspects of cosmology and the origin of the universe may be explored by gamma-ray observations. A.R.H.

N78-27035# Laboratorio di Ricerca e Technologia per lo Studio del Plasma nello Spazio, Frascati (Italy).
PHYSICS OF THE INTERPLANETARY SPACE FROM AN OUT-OF-ECLIPTIC MISSION
G. Moreno, L. Rossi (Lab. Astrofis. Spaziale), and M. Storini Jul. 1977 143 p refs Presented at the 62nd Meeting of the Ital. Phys. Soc., Trento, Italy, 28 Sep. - 2 Oct. 1976
(LPS-77-17) Avail: NTIS HC A07/MF A01

Open problems are considered in various fields of space science, which could be resolved by out-of-ecliptic observations at high heliographic latitude. The interplanetary plasma and magnetic field are discussed. Cosmic rays of galactic and solar

origin are dealt with, as is interplanetary dust. The most relevant solar phenomena are considered. ESA

N78-27036# Laboratorio di Ricerca e Technologia per lo Studio del Plasma nello Spazio, Frascati (Italy).
THE PHYSICS OF MAGNETIC RECONNECTION IN SPACE PLASMAS
M. Dobrowolny Nov. 1977 31 p refs
(LPS-77-24) Avail: NTIS HC A03/MF A01

Basic concepts of magnetic reconnection are illustrated and the importance of this process in space is discussed. An outline of theories presently pursued is given. Applications of such theories to two explosive phenomena, which involve magnetic merging, namely, the solar flares and the earth's magnetic substorms, are discussed. ESA

N78-27037# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics.
INTERSTELLAR CLOUDS AND THE FORMATION OF STARS
Hannes Alfven and Per Carlqvist Dec. 1977 37 p refs
(TRITA-EPP-77-20) Avail: NTIS HC A03/MF A01

The theory and properties of cosmic plasma are reviewed and the general belief that star light is the main ionizer is shown to be doubtful. The magnetohydrodynamic aspects of cosmic plasma clouds are discussed and it is concluded that magnetic fields may pinch the cloud, while magnetic compression may be the main mechanism for forming interstellar clouds and keeping them together. The formation of stars in a dusty cosmic plasma cloud is also discussed. ESA

91 LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights.

For spacecraft design see *18 Spacecraft Design Testing, and Performance*. For space stations see *15 Launch Vehicles and Space Vehicles*.

No abstracts in this category.

92 SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots.

N78-27038# Naval Ocean Systems Center, San Diego, Calif.
SOLAR H-ALPHA FLARE ATLAS BASED ON NOSC VIDEOMETER DATA
P. E. Argo and W. Loomis 5 Jan. 1978 115 p
(AD-A053121; NOSC/TD-140) Avail: NTIS HC A06/MF A01 CSCL 03/2

A solar flare measuring system, developed by this center and employing semiautomated computer-video techniques, was used in a flare patrol network to study fine temporal structure during optical flares and to afford direct comparison with both radio and X-ray data. Flare data collected between January 1971 and June 1974 are presented, comprising both a summary of peak area, brightness, and times as well as more complete time history profiles on an event-by-event basis. GRA

93 SPACE RADIATION

Includes cosmic radiation and inner and outer earth's radiation belts.

For biological effects of radiation see *52 Aerospace Medicine*. For theory see *73 Nuclear and High-Energy Physics*.

N78-27039 Washington Univ., Seattle.
HIGH RESOLUTION OBSERVATIONS OF COSMIC RAYS OF Z < OR EQUAL TO 30 Ph.D. Thesis
Patrick Thomas Love 1977 242 p
Avail: Univ. Microfilms Order No. 7807946

High altitude balloon flights of a 6.6 steradian detector were used to measure the charge composition of the elements with 30 < or = Z < or = 60. The detector, composed of two independent systems, each 3.3 sq m steradians in area solid angle, which use pulse ionization chambers, a diffuse box Cherenkov counter and a multi-wire ionization hodoscope, exhibited excellent charge resolution characterized by a standard deviation in assigned charge of 0.20 to 0.25 charge units from Z = 12 to Z = 30. Individual elemental abundances measured for 26 < or = Z < or = 40 are consistent with the solar system composition apart from a significant underabundance of cosmic-ray Zinc (Z = 30). Dissert. Abstr.

N78-27040* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GAMMA-RAY LINE EMISSION ABOVE 8 MeV
C. J. Crannell and H. Grannell (Catholic Univ. of America) Jun. 1978 11 p refs Presented at Symp. on Gamma Ray Spectroscopy in Astrophysics, Greenbelt, Md., 28-29 Apr. 1978 Submitted for Publication
(NASA-TM-79563) Avail: Issuing Activity CSCL 03B

Gamma-ray line emission above 8 MeV provides a sensitive diagnostic tool for determining the spectra of energetic nuclei within astrophysical sources. Excited states produced by inelastic scattering, charge exchange, and spallation reactions in the abundant nuclear species were considered in order to identify nuclear lines which contribute to the gamma ray spectrum. The cross sections for production of most high-energy states were sparsely measured. Those which were determined are comparable to the cross section for production of the 15.11-MeV level in C-12 with few exceptions. The branching ratios for gamma ray and particle emission are, however, better known. Of those states considered, 44 have measured branching ratios greater than 40% for emission of a gamma rays with energy above 8 MeV. G.G.

N78-27041*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE COSMIC X-RAY EXPERIMENT ABOARD HEAO-1
R. Rothschild, E. Bolt, S. Holt, P. Serlemitsos, G. Garmire (California Inst. of Technology, Pasadena, Calif.), P. Agrawal (California Inst. of Technology, Pasadena, Calif.), G. Reigler, S. Bowyer (California Univ., Berkeley, Calif.), and M. Lampton (California Univ., Berkeley, Calif.) Jun. 1978 59 p
(NASA-TM-79574) Avail: NTIS HC A04/MF A01 CSCL 03B

The HEAO-1 A-2 experiment, designed to study the large scale structure of the galaxy and the universe at X-ray energies is described. The instrument consists of six gas proportional counters of three types nominally covering the energy ranges of 0.15-3 keV, 1.2-20 keV, and 2.5-60 keV. The two low energy detectors have about 400 sq cm open area each while the four others have about 800 sq cm each. Dual field of view collimators allow the unambiguous determination of instrument internal background and diffuse X-ray brightness. Instrument characteristics and early performance are discussed. A.R.H.

99 GENERAL

N78-27042*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AMES RESEARCH CENTER PUBLICATIONS-1976
Betty Sherwood May 1978 168 p refs
(NASA-TM-78493; A-7346) Avail: NTIS HC A08/MF A01 CSCL 05B

Bibliography of the publications of Ames Research Center authors and contractors, which appeared in formal NASA publications, journal articles, books, chapters of books, patents, and contractor reports. Covers 1976. Author

N78-27043*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

APPLICATION OF A COST/PERFORMANCE MEASUREMENT SYSTEM ON A RESEARCH AIRCRAFT PROJECT

James J. Diehl Jun. 1978 24 p refs

(NASA-TM-78498; A-7488) Avail: NTIS HC A02/MF A01 CSCL 05A

The fundamentals of the cost/performance management system used in the procurement of two tilt rotor aircraft for a joint NASA/Army research project are discussed. The contractor's reporting system and the GPO's analyses are examined. The use of this type of reporting system is assessed. Recommendations concerning the use of like systems on future projects are included. A.R.H.

N78-27044# International Meteorological Inst., Stockholm (Sweden).

[RESEARCH ACTIVITIES IN DYNAMICAL METEOROLOGY AND GEOPHYSICAL FLUID MECHANICS, ATMOSPHERIC CHEMISTRY, AND ATMOSPHERIC PHYSICS] Annual Report, Jul. 1976 - Jun. 1977

Nov. 1977 28 p refs

(AR-76-77) Avail: NTIS HC A03/MF A01

Research activities for the year July 1976 to June 1977 in dynamical meteorology and geophysical fluid mechanics; atmospheric chemistry, and atmospheric physics are summarized. Visitors to, financial details of, seminars given at, and publications by the Institute are listed. ESA

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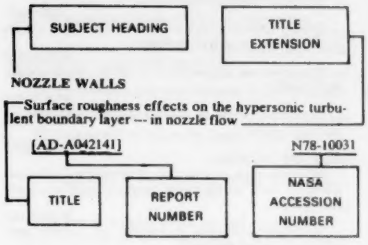

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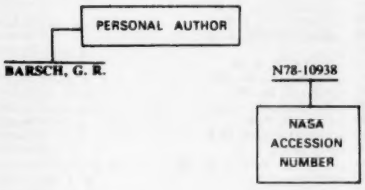

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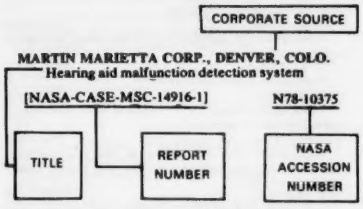

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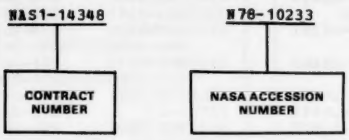

Listings in this index are arranged alphanumerically by contract number. Under each contract number the NASA accession numbers denoting documents that have been produced as a result of research done under that contract are arranged in ascending order. The NASA accession number denotes the number by which the citation is identified.

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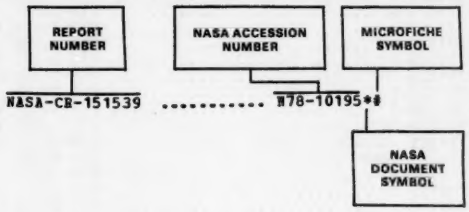

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AD-A052891 ..... N78-26766 #
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AD-A052905 ..... N78-26831 #
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AD-A053016 ..... N78-26752 #
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AD-A053121 ..... N78-27038 #
AD-A053144 ..... N78-26378 #
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AD-A053154 ..... N78-26359 #
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AD-A053208 ..... N78-26393 #
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AD-A053210 ..... N78-26355 #
AD-A053211 ..... N78-26110 #
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AD-A053220 ..... N78-26137 #
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AD-A053263 ..... N78-26204 #
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AFGL-TR-78-0001 ..... N78-26681 #
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AFIT/GA/EE/77-5 ..... N78-26135 #
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AGARD-CP-234 ..... N78-26460 #
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AIAA-PAPER-78-1034 ..... N78-26173*#
AIAA-PAPER-78-1119 ..... N78-26878*#

AIM-306 ..... N78-26769 #
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ANL/CES/TE-77-3 ..... N78-26381 #
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BNL-23353 ..... N78-26411 #
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CONF-770696-5 ..... N78-26909 #
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CONF-771015-13 ..... N78-26193 #
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CONS-0008-3 ..... N78-26997*#
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COO-2769-2 ..... N78-26590 #
COO-2835-1-REV ..... N78-26453 #
COO-2874-20 ..... N78-26639 #
COO-2917-5 ..... N78-26224 #
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COO-2939-3 ..... N78-26402 #
COO-3049-9 ..... N78-26640 #
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CSU-ATSP-278 ..... N78-26700*#

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CTH-ITP-TMF-77-1 ..... N78-26882 #

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DOE/NASA/1011-78/25 ..... N78-26098*#
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DOE/NASA/1022-78/33 ..... N78-26548*#
DOE/NASA/1022-78/34 ..... N78-26549*#

DOE/NASA/1022-78/38 ..... N78-26554*#
DOE/NASA/1022-78/39 ..... N78-26555*#
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E-9517-1 ..... N78-26145*#
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ECRC/M-1084 ..... N78-26386 #
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EDA-78-056 ..... N78-26616 #
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EPA-450/2-76-016-VOL-2 ..... N78-26648 #
EPA-450/2-77-021A ..... N78-26664 #
EPA-450/2-77-032-VOL-3 ..... N78-26649 #
EPA-450/2-77-033-VOL-4 ..... N78-26650 #
EPA-450/2-77-034-VOL-5 ..... N78-26651 #
EPA-450/2-77-037 ..... N78-26660 #
EPA-450/2-78-003A ..... N78-26655 #
EPA-460/3-77-018 ..... N78-26626 #
EPA-600/1-77-054 ..... N78-26662 #
EPA-600/1-78-006 ..... N78-26731 #
EPA-600/2-77-216 ..... N78-26999 #
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EPA-600/3-78-019 ..... N78-26661 #
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ESL-TM-821 ..... N78-26781*#

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ETL-0118-VOL-2 ..... N78-26351 #
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FCC/OPP/UTP-78-01 ..... N78-26371 #

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FE-1216-2 ..... N78-26572 #
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FE-2246-3-REV-A ..... N78-26581 #
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